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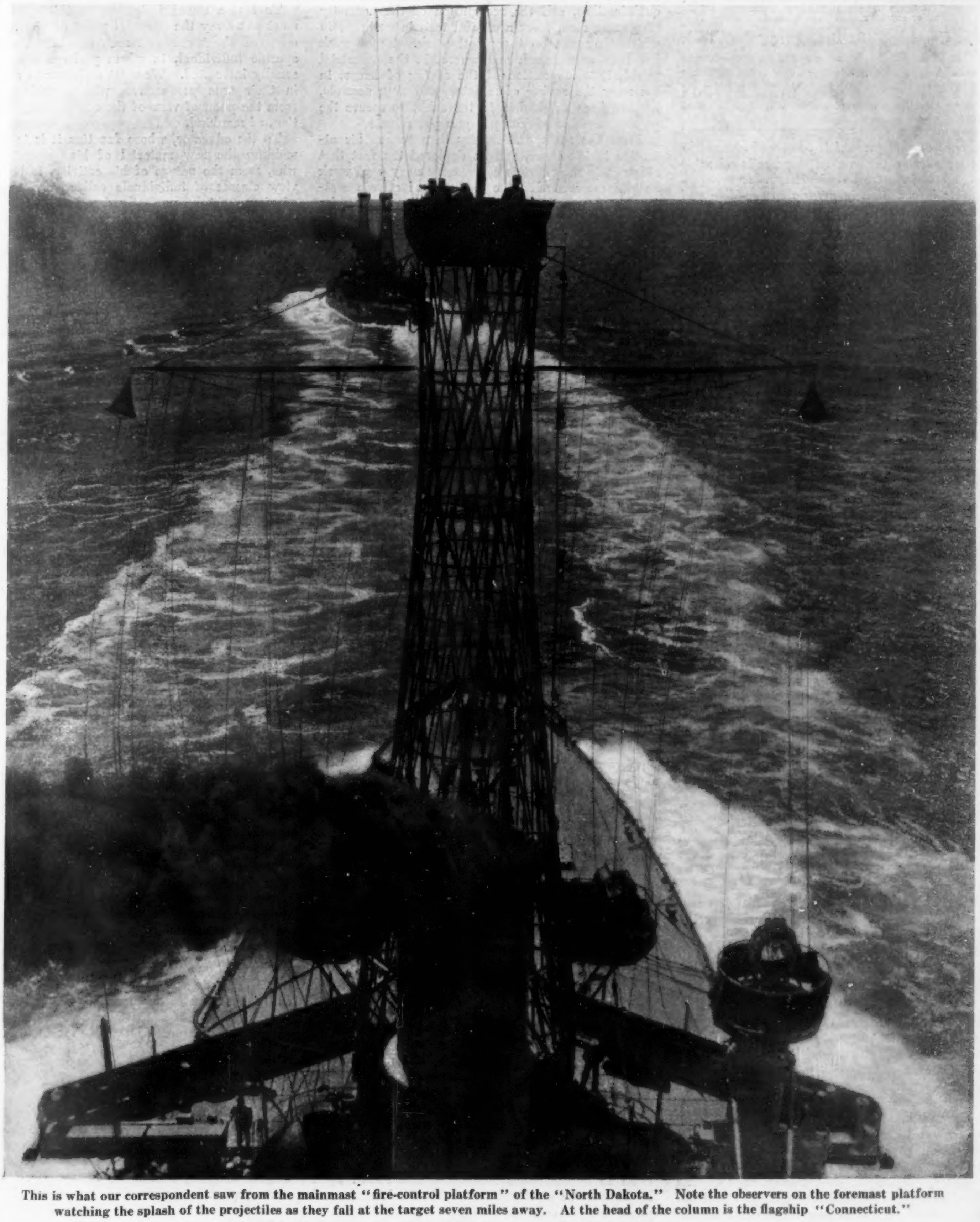

This is what our correspondent saw from the mainmast "fire-control platform" of the "North Dakota." Note the observers on the foremast platform watching the splash of the projectiles as they fall at the target seven miles away. At the head of the column is the flagship "Connecticut."

ON THE "FIRING LINE" ABOARD THE "NORTH DAKOTA."—[See page 544.]

# SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.*

## The Demand for a Better Parcels Post

NOW that the Rural Free Delivery Service and the Postal Savings Banks, the two new features which have been added to the business of the Post Office within the past few years, are so successful and convenient, it is time measures be adopted to improve the existing limited parcels post. This can best be done by lowering the rates and extending the weight limit, in order that they may conform, in some measure, to the present world's Postal Union standards.

At a conference of the Postal Progress League in this city on May 24th last it was proposed and recommended that the postal rate for parcels be reduced from sixteen cents to eight cents a pound, and that the limit of weight for a single parcel be increased from four to eleven pounds; that all mail matter be insured; and that a still lower rate be established for the carriage of parcels on the Rural Service Routes.

These features, it was stated, were included in a bill known as the Sulzer bill, introduced at the present session of Congress by the Hon. William Sulzer of New York, which has been referred to the House Committee on the Post Office and Post Roads. This committee has appointed June 14th next, at Washington, D. C., as a day for a public hearing on the subject. Every one interested should address a letter to the chairman of that committee.

When it is understood that one of our largest express companies is carrying parcels post packages from Great Britain and delivering them to any part of the United States at the rate of about two and one half cents a pound, it will be safe to assume that the rate of eight cents a pound as suggested in the Sulzer bill, is a conservative one.

The benefits of an extended parcels post can hardly be measured in words. It will enable the producer to trade directly with the consumer on an equitable basis, since merchandise is transported and distributed everywhere, regardless of the distance, at one, single uniform rate. We believe the time is close at hand when favorable action by Congress can be expected.

## Scientific Management on Sea and Shore

IN an age when dissatisfaction with many of the Government departments is all too rife, it is refreshing to realize that there are certain of them to which the nation can turn with genuine satisfaction. Prominent among the latter is the United States navy, which, as represented by the noble fleet of vessels now in commission, is regarded with confidence and pride by the people of this country.

We doubt if the navy has ever received a compliment which gave greater satisfaction, from the Secretary down to the youngest enlisted man, than that bestowed by the scientific management experts who have recently been cruising with the fleet for the purpose of determining how far it could be bettered by the application of the principles for which they stand.

Referring to this matter in his recent speech before the Economic Club of the City of New York, Secretary of the Navy G. v. L. Meyer called attention to what has been accomplished on the battleship through practice of scientific management, which, although not known by this name, has been followed in the fleet for many years, and has brought about a wonderful increase in efficiency, particularly in the matter of gunnery. The experts on scientific management, during their cruise with the fleet, witnessed the whole of the operations involved in carrying out a "battle practice," and on their return they reported to the Secretary that the battleship was the finest exhibition of scientific management they had ever seen. The methods by which the present conditions have been brought about are exactly those which form the fundamental principles of scientific shop management. This involves a systematic study of the men and their qualifications, and the recognition of the necessity of placing men, after a careful test, in positions in which they can do their best work. Team work has been encouraged, and where, in the industrial world, it is a question of the saving of hours, in the navy the saving of minutes, and even seconds, has not been overlooked in the effort to secure the greatest number of hits per gun per minute.

From the sea the Secretary then turned his attention to the shore, and he deplored the fact that although in the effort to concentrate navy yard work he had recommended the abolition of certain scattered and practically useless navy yards, thereby saving an annual maintenance expense of $1,600,000, not a single navy yard had as yet been abolished by Congress.

The navy yards are a constant and unnecessary drain upon the resources of the navy. Certain first-class and strategically well located yards, such as those at New York, Boston, Philadelphia and Norfolk, are, of course, a necessity; but the number of yards on the Atlantic coast and the Gulf of Mexico is excessive and in many cases they are not well placed. This condition of things has been brought about in some yards by the desire on the part of Congressmen to have navy yards located in their States; while other yards, which were established in colonial days, have been built up unnecessarily, the individual member being ambitious to see the yard in his State at least equal in importance to those in other States, and failing to take into consideration its value from a military and economic point of view. As a result, we have on the Atlantic Coast nine navy yards, on which in some instances money has been expended lavishly. This would not have happened if the strategic and economic point of view only had been considered.

Surely the reasons advanced for getting rid of these obsolete stations, with their "needless drain upon the Government's financial resources," are sufficiently cogent to satisfy any member of Congress who has the national interests sincerely at heart. New Orleans, we are told, is badly located. Its position, 100 miles up the river, is such that in time of war, or threatened war, no large vessels should be sent there on account of the danger of the passes being blocked. Florida now has two navy yards, and by the abolishment of Pensacola there would still be left one yard, Key West, in an advantageous position. South Carolina has two yards, Port Royal and Charleston. The yard at Port Royal is absolutely useless. It has a dock, built at a cost of about $500,000, which cannot be approached by a battleship. Sacketts Harbor is located on Lake Ontario. New London is nothing more than a coaling station back of the New York, New Haven and Hartford Railroad bridge. San Juan and Culebra are unnecessary and unused; while Cavite, at Manila, has cost the Government since 1898 eleven millions of dollars.

## Education and Success

WHILE the value of a higher education is in our day fairly generally appreciated, there are not wanting voices that ask: What gain does this education bring to the individual? Is it not true that we see men of little or no schooling winning in the race, over others who have had every opportunity that institutions of learning can offer? Nay, more, are there not numberless instances of men to whom their very education has been a stumbling block, whom it has made blind to opportunities recognized and seized upon by their more alert brothers of less schooling, and perhaps more common sense? Do we not see educated men following after dreams and visions, while their more practical, though less erudite fellows, are gathering a material harvest?" In brief: "Is education on the whole conducive of success?"

If by education were meant an ideal education, we should hardly hesitate to answer with an emphatic "Yes." In so far, however, as actual education departs from the ideal, there will, of course, be instances in which it fails to lead to the highest degree of success that might have been attained with a given raw material under prescribed circumstances. This accounts, at least in part, for the more thoughtful of the doubts and criticisms to which we have referred. Not so for others. The fallacy of these is the narrow, distorted and false point of view from which they are framed. It may be true, and indeed it *must* be true, that, counting only the material advantages accruing to the individual, education in isolated cases will bring loss rather than gain. But do these material advantages to the individual alone measure his "success"?

To cast a sound judgment on this question, we must put away the personal point of view, whether centered about our own self, or about some other specific individual, in whom perhaps we are personally interested. We must endeavor to see things in their true perspective, with a wider outlook, from the point of view of the community, of the nation, of mankind.

To the educator, whose function it is to assist in molding the raw material of his generation, and who, from the nature of his activity, is brought to view classes of individuals collectively, this point of view must be perfectly familiar. Is it not an obvious sign of some imperfection in the methods or materials with which he has worked, if this or that individual of his charge in later years accumulates personal profits at the expense of his fellows without due compensation? Yet, so long as he keeps within the law and accepted custom, he may do this and be reckoned by many a "success," because they take only a personal survey of the situation and lose sight of the interests of the community.

While flagrant breaches of the principles implied above are recognized by all as criminal, it is far from being generally understood that every "success," which is success only from a personal standpoint, is in fact a failure. The truth of this is perhaps more easily seen by referring to exceptional cases, in which the values involved are so great as to be patent to all. We read in Tyndall's biography of Faraday: "This son of a blacksmith had to decide between a fortune of £250,000 on the one side, and his unendowered science on the other. He chose the latter, and died a poor man." Was Faraday, therefore, a failure, or would he not rather have been a sad failure indeed, had he amassed several times the sum mentioned, in an occupation that had prevented his giving to the world those classical researches which form the very foundation of modern electrical theory and practice? For surely, in proportion as a man finds a sphere of action in which his services to mankind approach most nearly the utmost of which his natural endowments and his development render him capable, in so far has he achieved success.

But, some may say, barring exceptional cases, is not the world's estimate of the value of a man a very fair approximation to the truth? Is not, in general, the price of a man's services very nearly equal to their value? If so, then his success, as defined above, will be greatest when he is earning a maximum—so that we come back to a very ordinary conception of "success."

To this the reply seems to be, that the world's estimate of a man's services is indeed, broadly speaking, a fair approximation to the truth, in most cases, but we are not here concerned with the case that represents the rule—there seems to be a fairly general agreement that as a rule, a higher education is an aid toward success; the cases which are of interest in our present discussion are the exceptional cases, in which apparently the result of education has been to handicap the individual. Is not the explanation of at least some of these cases to be found in the disparity between the value of services rendered and their market price? It must be remembered that market price depends upon human judgment, which is fallible, while absolute value is fixed by natural law. Have not some men been counted failures, owing to false perspective, who should be reckoned among successes? And perhaps conversely, do we not often hastily pronounce a man a success because of his accumulated profits, without counting the cost to the community?

And what is our conclusion in fine? Education, in so far as it approaches the ideal, is unquestionably conducive of the highest success, if only we have the right idea of what constitutes success: *Your success is measured, not by what the world gives to you, but by what you give to the world.*

## Recent Airship Disasters

IN our last issue we published an article by Mr. Carl Dienstbach in which the disasters that had befallen the new Zeppelin, the "Parseval II.," and the "Morning Post" airships, were critically commented upon. We publish herewith two illustrations which help to bear out the contentions made in that article—that the airship is inherently safe, but that the methods of docking it, depending, as they do, upon the concentrated action of many men, are hopelessly crude.

The "Morning Post" airship, which was built by the Lebaudys, has had the usual trials and tribulations. At the very end of its fine journey from Moissons to Farnborough, in 1910, the vessel was wrecked in docking. An iron girder projecting from the roof of the shed ripped up the envelope. When the repairs were completed, which took several months, an ascent was made with Louis Capazza in charge. After maneuvering at a considerable height, it was decided to descend. Near the ground the engines were stopped. Three times the soldiers below tried to grasp the tow ropes and to pull the craft down. The great ship drifted past them, the guide rope trailing across trees and sheds, with the result that the vessel was swung around broadside to the wind, all but unmanageable. The 200 horse-power engines were started up again, but not until it was too late. The ship crashed into some fir trees, the envelope was pierced, and the craft dropped, a mere mass of wreckage, in front of a cottage. Fortunately, no one was injured. If any airship mishap ever indicated the necessity of a more efficient means of bringing a huge aerial vessel to anchor, surely this disaster indicates it.

Time and time again the SCIENTIFIC AMERICAN has pointed out that an airship should be moored to an anchoring tower, around which it can swing with the wind, as unhampered as a weather vane, and from which it can drift away when starting. The accompanying picture of the wrecked "Deutschland" is an argument in favor of that plan. To prevent the wind from forcing the airship against one of the walls of the shed while it is partly within the shed, a wind break was erected, which appears in our illustration as a wall-like projection from the entrance. It was this wind break that proved the "Deutschland's" undoing. A heavy gust of wind caught her and pounded her down on the sharp edge of the wooden wall. As a result, the back of the vessel was broken. It is reported that two hundred men were unable to hold the craft down.

**Front view of Morane monoplane fitted with a Gnome motor.**

**Vedrines in flight.**

**Vedrines, the winner of the Paris-Madrid race at 60 miles an hour.**

## The Paris-Madrid Aeroplane Race

THE first of the series of big cross-country aeroplane flights scheduled for this summer—the race from Paris to Madrid—was started from the aerodrome of Issy-les-Moulineaux early in the morning of Sunday, May 21st. A vast crowd of 200,000 people surrounded the aerodrome, and was kept back from the lines with difficulty by the soldiers. In order that they might see the start from a position of advantage the French Premier, M. Monis, and the Minister of War, M. Berteaux, with their friends, took a position inside the lines about half way down the field. In a fresh breeze of 17 or 18 miles an hour, the first four aviators made excellent starts and got away without difficulty. The fourth, M. Pierre Vedrines, in his Morane monoplane, in which he has of late made many remarkable flights, was obliged to descend before reaching the end of the field, and his machine was badly damaged. The next of the twenty entrants to start was M. Emile Train, one of the newer French constructors, who has met with considerable success of late and received an order for 15 machines from the government. With his passenger, M. Bounier, beside him, Train rose readily and started down the field. Just then, seeing that the crowd was encroaching, some curaissiers galloped across the aerodrome in order to drive the people back. At the same moment Train's motor failed him and his machine began to descend. Fearing lest he should fall upon the soldiers, he swerved to the left and landed directly in front of the ministerial party, who were unable to get out of the way. Premier Monis was knocked flat by his son and thus was saved from serious injury, but the monoplane struck the Minister of War squarely, the propeller severing one arm as though cut by a surgeon's knife. His head was crushed, and he was killed instantly.

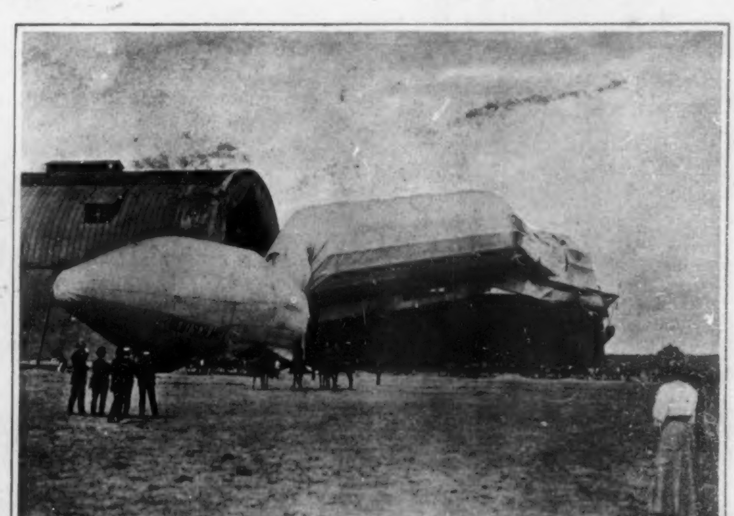
It was at first feared that the Premier's injuries might prove fatal also, but fortunately this was not so. The race was postponed until the next day, when Vedrines started again on a new Morane monoplane and made a very fast and successful flight to Angouleme, 279 miles away, in 3 hours and 43 minutes, at an average speed of 75 miles an hour.

Of the four aviators who started Sunday, M. Roland Garros was the only one who reached Angouleme the same day. He made the flight in 5 hours and 1 minute, requiring an hour and 18 minutes longer with his Blériot than Vedrines required with his Morane. M. Levasseur lost his way in a fog and landed near Cosne, 100 miles from Paris. Beaumont (the pseudonym taken by Naval Lieut. Conneau) descended at Azay-sur-Imbre (90 miles), and in attempting to resume his flight, he damaged the left wing of his Blériot by hitting a tree. M. Gibert reached Pontlevoy, some 110 miles from Paris, on the first day. On Monday he continued his flight with his Blériot, reaching Angouleme at 10:54 A. M. In doing this, he lost his way and landed at Brezay, near the island of Bouchard. After inquiring his way he resumed his flight and landed safely at Angouleme. His time for the flight is given as 8 hours and 55 minutes. On account of his accident on Sunday, M. Train withdrew from the race. Vedrines tried again, however, as mentioned above, and his partner, M. Frey, in another Morane monoplane, followed him at 2:06 P. M. He only succeeded in reaching Etampes, some 25 miles from Paris, where his machine was caught in a squall and plunged to the ground, luckily without injury to the aviator.

The second stage of the Paris-Madrid race, namely from Angouleme to San Sebastian via Bordeaux and Biarritz, was flown on Tuesday, May 23rd, successfully by Vedrines, Garros, and Gibert. Vedrines was the first to arrive, although he was the last to leave Angouleme, at 7:10 A. M. He covered the 190 miles without a stop in 3 hours and 49 minutes, arriving

(Continued on page 5[illegible].)

**Wrecked frame of the British dirigible "Morning Post."**



**Wreck of the Zeppelin airship "Deutschland II."**

**WRECKED AIRSHIPS AND THE WINNING MONOPLANE IN THE PARIS-MADRID RACE**

# Hitting the Target at Seven Miles

## Battle Practice in the United States Navy

Two targets being towed by the battleship "South Carolina."

IT IS fitting that in these days target practice should be attracting more attention in the United States Navy than any other feature connected with the active operations of the fleet in commission. For every school boy knows that it was to the proficiency of the American gunners that our ships in the war of 1812 were indebted for many a victory.

The first opportunity afforded to American officers and crews to demonstrate their marksmanship with modern rifled guns of great power was at the battle of Santiago. Most of the fighting on that occasion was done at the very short ranges (for rifled guns) of 2,000 to 3,000 yards. The day was clear and our gunners were not hampered by a storm of well-aimed projectiles from the enemy. So inefficient and demoralized were the Spanish gunners that they forgot to change the sights on their guns as our ships closed in to short range; and consequently their shells flew high, passing over the American vessels.

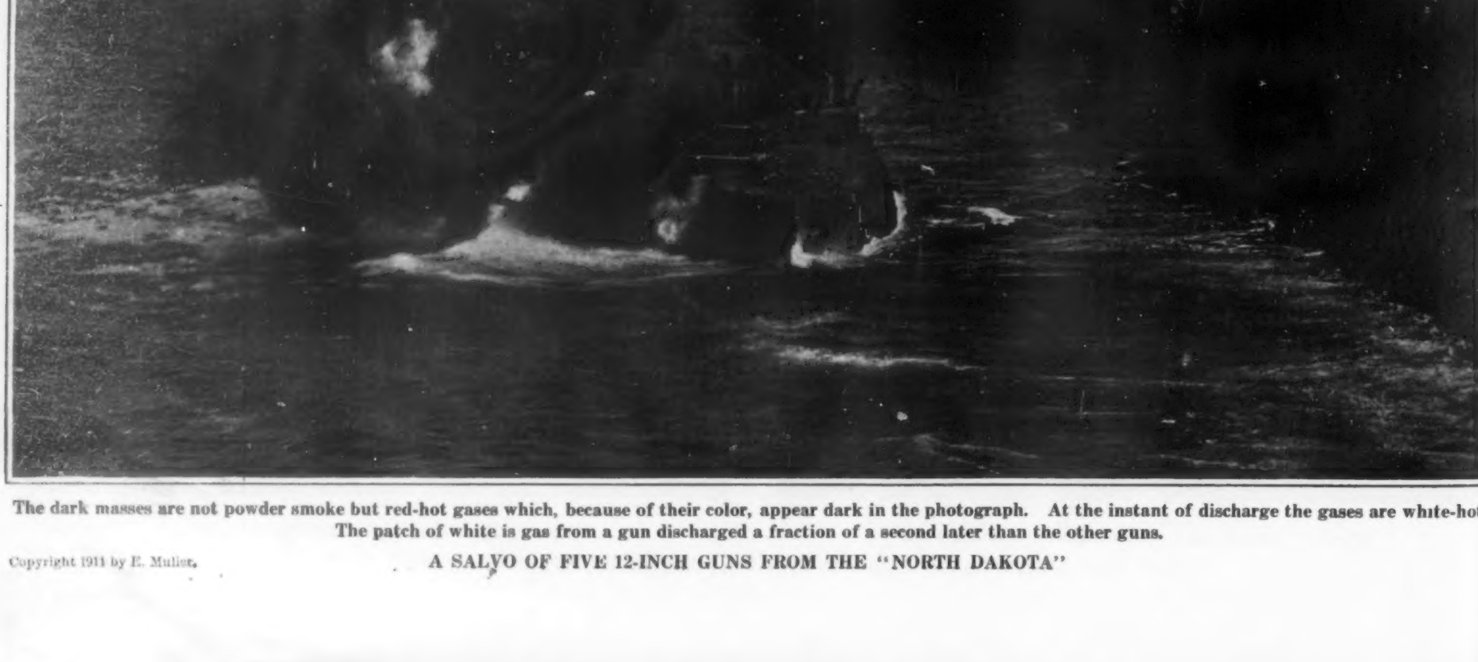
Instead of dispersing radially as they cleared the harbor entrance, the Spaniards steamed in single column parallel with the coast, our ships following in a roughly-parallel column formation. Closing in to short range, our ships proceeded to pour a storm of shell, big and little, into an enemy that was steaming abreast of him and unable, because of the lee shore, to do anything but take what was coming.

Now it will be evident to the veriest tyro that as far as the American gunners were concerned, the "target" conditions were everything that could be asked, including, as they did, a clear atmosphere, short range, ample time, and an enemy that was too much rattled to hit back.

But what was the result? Out of the total number of projectiles (if we remember rightly, about 9,000) fired at the Spanish ships at what to-day would be point-blank range, not more than 3½ per cent touched the Spanish ships.

In other words, out of every one hundred shells fired at this practically helpless quartette of fleeing vessels, ninety-six and one-half missed them altogether and embedded themselves in the wooded slopes of the southern shores of Cuba.

These are facts that have never been disputed, and



The dark masses are not powder smoke but red-hot gases which, because of their color, appear dark in the photograph. At the instant of discharge the gases are white-hot. The patch of white is gas from a gun discharged a fraction of a second later than the other guns.



A SALVO OF FIVE 12-INCH GUNS FROM THE "NORTH DAKOTA"

indeed, only last week, Mr. Meyer, the present Secretary of the Navy, at the annual dinner of the Economic Club, New York city, gave 3½ per cent as the official estimate of the shooting efficiency of our navy in 1898.

It is not our intention to give here any history of the development of target practice, with the corresponding rise in efficiency of gunnery in the United States Navy. It is sufficient to say that in the intervening dozen years or so since the Santiago battle, our shooting has so far improved that, whereas at that time the record stood at 3½ per cent of hits at 3,000 yards, to-day it stands at 33 1/3 per cent of hits at 10,000 yards. This last record was obtained in target practice carried out under what are known as "battle practice" conditions.

In battle practice, an effort is made to reproduce, as far as possible, the exact conditions which are liable to be met with in time of war. During hostilities, when a hostile fleet is sighted, neither its distance, nor the speed at which it is moving, nor its exact course will be known. The American admiral may deem it advisable to force an immediate engagement, and, following the time-honored principle of our naval commanders, that the best defense is a very vigorous offense effected at the earliest possible moment, he will open the engagement at the longest possible range at which his big guns will be effective. At present this maximum range is from 13,000 to 14,000 yards.

Furthermore, it may well happen that the enemy will be discovered in rather stormy weather, when a considerable sea is running and the ships are rolling through an angle of many degrees. In this case, to the disadvantage of a far-distant target will be added that of an unsteady gun platform; and it can readily be understood that under such conditions, only a gunner who had received careful training under similar conditions during times of peace, would have any chance whatever of damaging the enemy.

The very interesting set of views which we publish in this issue illustrates the methods by which our officers and men are trained to such a degree of efficiency that they can go out upon the high seas in search of the enemy's fleet, and just as soon as he is sighted, even if he be seven or eight miles away and the seas are running high, be able in a very short time to determine his distance, and pour in upon him a storm of heavy, armor-piercing, high-explosive, 12-inch shells.

The target consists of a steel pontoon with pointed bow and stern, which is ballasted until its deck is awash. Mounted along the center line of the pontoon is a series of tall, stout masts, across which are fastened lines of light wood scantling. Over this framework is drawn a large net, and upon the netting from top to bottom of the structure are placed three vertical strips of canvas, one at each end and one at the center. The target as thus formed is a parallelogram 60 feet in width and extending 30 feet above the surface of the water. It is towed through the water by a powerful tug, or a cruiser, upon the after-deck of which is stationed an observation party, whose duty it is to observe by the splash just where the projectiles strike the water, that is to say, whether they fall 500, 200 or 50 yards in front of the target, or whether they fall so many yards beyond, the point at which the shell strikes being shown by a vast column of spray which rises far into the air.

Battle practice is now carried out preferably in rough weather; for it is assumed that if our gunners can hit the target when the ship is rolling or pitching in a seaway, they can certainly do so in calm water.

The target, then, is being towed at an unknown speed, which may be anywhere from 4 to 12 knots. The ships that are to engage in the firing steam on a course approximately parallel to that of the target, at a distance which is not known to the ship, and which may be anywhere from 9,000 to 13,000 yards. The distance or range is first approximately determined by a mechanical range-finder, in which the angles sighted at the two ends of a base line of known length are used to calculate the distance. The base line may be a horizontal line of 500 feet, which is the length of the ship, or it may be a vertical line of 100 feet or so afforded by the mast.

The modern basket or lattice-work mast, which forms such a distinguishing feature of American battleships, plays a most essential part in target practice. On top of this mast is what is known as the fire-control platform. On the platform are certain officers provided with powerful telescopes or field glasses, whose work it is to observe from their lofty point of vantage, where the projectiles fall. This they can do by observing the splash. After the column of spray has subsided, it leaves a whitish patch on the ocean; and the officer, through his glasses and by virtue of his long practice, can tell with remarkable accuracy how far this patch of water lies in front of or beyond the target.

After the mechanical range-finder has given the range as, say 10,000 yards, a single gun is elevated to the proper degree for that range, and a trial shot is fired. If the splash falls 200 yards short of the target, the guns are elevated by the right amount to make the next shot a hit. If the shot is 100 yards beyond the target, the elevation is reduced correspondingly.

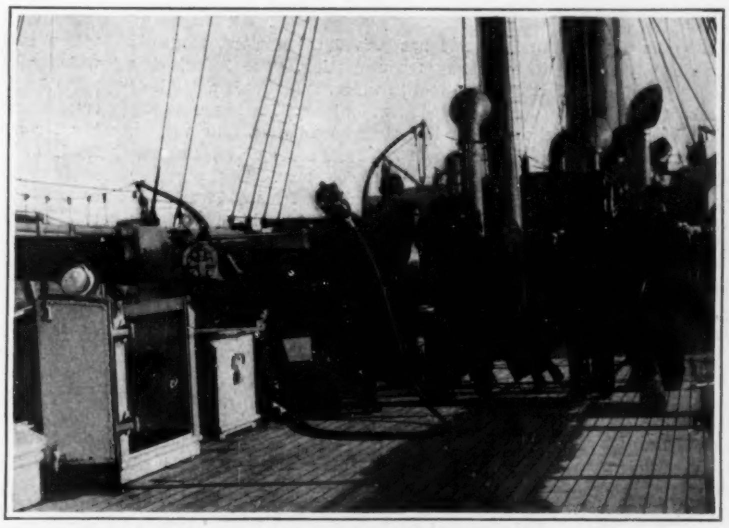
The observing officers on the platform, however, are 120 feet above the sea, whereas the 12-inch guns in the turrets are 90 or 100 feet below the platform, and some of them fully 300 feet away on the quarter-deck. It is necessary that means be provided for instantly communicating to the turrets the results of the fire-control observations. This is done in the following way. On the inside of the breastwork of the platform is a set of voice-tubes, telephones and other means of communication, which lead down to a "central station" which is heavily protected with armor. This station is connected by telephones and voice-tubes with every gun position throughout the ship, and from the central station the various gunners throughout the ship receive the correct range for the time being.

It will be understood that the fire-control officers are very busily engaged as the ship steams past the target. It may be that, as in the case of the "Michigan," when these pictures were taken, the vessel is steaming 17 knots an hour, while the target may be steaming 4 to 10 knots on a parallel but opposite course. Consequently, the range will be continually and rapidly changing, and the fall of the shots must be carefully watched, and the necessary changes in elevation sent to the gunners with the least possible delay.

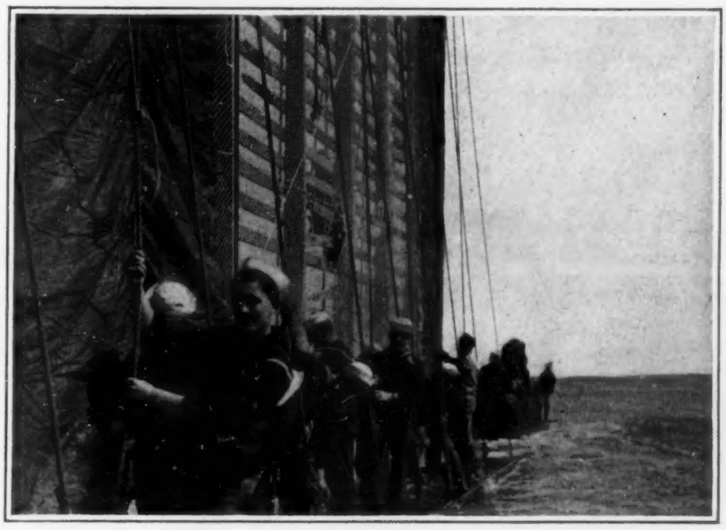
The recoil of the 12-inch guns causes the ship to heel; a ten-gun salvo on the "North Dakota" heeling the ship 5 degrees. The ship is steadied by firing the next salvo as the ship rolls toward the target. If a series of salvos was fired on the roll away from the target, it would be possible to throw the ship on her beam ends by the cumulative effect of the recoil.

It is probable that no other nation is carrying on target practice at such extreme ranges as the United States. It is known that the British Navy rarely does any shooting beyond the 7,500-yard range, this being the extreme range at which good shooting can be done in the hazy atmosphere of the North Sea; and it is for the North Sea battle that Great Britain is holding herself prepared. The SCIENTIFIC AMERICAN is often asked to compare target practice results in our navy with those of the foreign fleets. This, because of the difference in the ranges and in the weather conditions, it is difficult to do; but, in view of the fact that our battle practice is done in rough weather, and at ranges of from 9,000 to 13,000 yards, and that under these adverse conditions so high a percentage of hits is obtained, it is safe to say that the United States gunners stand at least abreast of those of any other navy.

In estimating the importance of the new standard of efficiency in long-range gunnery, we must remember that our new 50-caliber 12-inch gun will penetrate the armor of most battleships, even at great distances; and the new 14-inch gun will penetrate any armor at any range at which the hulls of the ships are visible.



**The man at this 7-inch gun is in communication with the central station by means of voice-tubes through which he is given the range.**



**Lowering the net on a target after it has been riddled by shells.**

**Observation party on quarter deck of towing ship plotting on a spotting board the fall of the shots at target.**

BATTLESHIP PRACTICE IN THE UNITED STATES NAVY

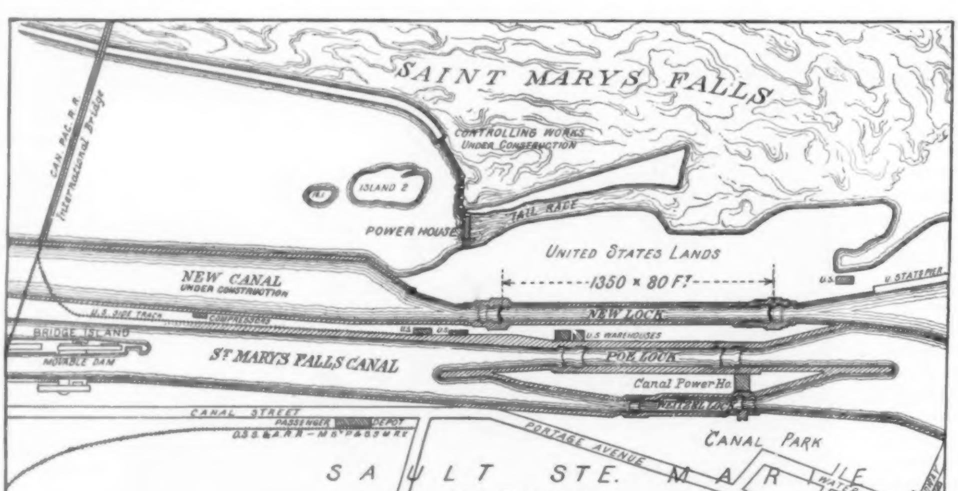
# The New Ship Canal and Locks of the St. Mary's River

## Construction of the Longest Lock in Existence to Accommodate the Great "Soo" Traffic

By James Cooke Mills

NEXT to Panama the most important and extensive engineering work now under way by the Federal Government is the new ship canal at the falls of the St. Mary's River. This waterway of the North, connecting Lake Superior with the lower lakes, already floats in its two canals with three locks the greatest commerce of any inland waters of the globe. In 1910 the tonnage amounted to 62,363,218, which was two and one-half times greater than that passing the Suez Canal, and seven times greater than that of the Kiel Canal. It exceeds the commerce borne by all the ships, British and foreign, entering the ports of Great Britain in an entire year. The lake merchant marine in tonnage and value is more than one-half of the entire shipping under American registry, and exceeds the whole marine of every foreign nation, excepting England and Germany.

The commerce of the Great Lakes, which now reaches 90,000,000 tons annually, is about one-sixth of the entire freight movement of the United States. It consists of iron ore, coal, grain, flour, lumber, stone and general merchandise, to the value of one billion dollars. Water transportation of this enormous tonnage effects a saving to the American people of $250,000,000 yearly, or more than one million dollars every day during the season of navigation. Nearly seventy per cent of this commerce flows through the St. Mary's River, the dredged channels of which are 34 miles in length, from 300 to 1,000 feet in width, and afford a minimum depth of 21 feet. The 600-foot ore carriers load on this draft about 13,000 tons or 435,000 bushels of wheat.




The Weitzel lock is 515 feet by 80 feet by 15½ feet deep; the Poe lock is 800 feet by 100 feet by 19½ feet; and the new lock now being built by the United States government is 1,350 feet by 80 feet by 24.5 feet. It will accommodate two 650-foot ships each carrying 25,000 tons at one lockage.

**NEW 1,350-FOOT LOCK AT SAULT STE. MARIE—WILL BE THE LONGEST IN EXISTENCE**

These bulk cargo ships, which are the largest of their class in the world, have a molded depth of 32 feet, and when fully loaded to their maximum draft of 25 feet, carry 20,000 tons. For every inch of increased draft over 21 feet, about 150 tons can be stowed in their capacious holds, and they steam through the open lakes at a speed of ten to twelve miles an hour. By mechanical means they load at the mammoth ore or coal docks in two to three hours, and discharge their cargoes in from four to six hours. Within five years the rock cuts of the St. Mary's River will afford a depth of 25 feet at low stage of water, and the new canal and locks, which are to be even longer than those of the Panama Canal, will pass these huge freighters loaded to their full capacity, which is their highest economic efficiency.

The present canals around the falls, one on each side of the international boundary, have a combined capacity of about 75,000,000 tons in 240 days—the average season of navigation. On the American side the canal was dug by the State of Michigan from 1853 to 1855, and was the first ship canal made within the borders of the United States. It was originally a little more than a mile in length, 64 feet wide on the bottom and 100 feet on the surface of the water, and 13 feet deep. At the lower end were two tandem locks of masonry, 350 feet long, 70 feet wide, 11½ feet deep, and each had a lift of 9 feet.

In the early seventies the lake commerce had increased to such a volume that plans were drawn by the government for a new lock, the construction of which was begun in 1876 and completed in 1881. It was named in honor of General Godfrey Weitzel, U. S. A., who was in charge of the work. This lock of solid masonry is still in use, and is 515 feet long, 80 feet wide, narrowing to 60 feet at the gates, and affords a depth at present lake levels of 15 to 16 feet. The canal was widened at this time to 160 feet, with timber piers having a vertical face, and the depth increased to 16 feet. In 1881 the control of the canal passed to the United States Government, and the tolls, which in twenty-six years amounted to $800,000, were forever abolished.

The great Poe lock, which is the largest in the world, replaced the State locks, and cost, including the canal enlargement, $4,765,000. This work was completed in 1896, and has proved the greatest economic factor in waterway transportation. The lock is 800 feet in length, 100 feet in width, and affords a depth of 19½ feet at extreme low water level. It will pass in one lockage, requiring less than 30 minutes, four vessels, two abreast, of length 380 feet, beam of 45, and carrying in the aggregate 20,000 tons. The cost per freight ton has thus been reduced from 13.57 mills in 1882 to 3.53 mills in 1909. During this period the wooden steam barge gave way to the modern steel ship, and the freight charges per mile-ton dropped from 2.3 mills to 0.78 of a mill.

In 1909 the freights to and from Lake Superior averaged: On coal, 31 cents per net ton; iron ore, 59 cents; grain, 2 cents a bushel; salt, 15 cents a barrel; lumber, $2.40 per thousand feet board measure, and general merchandise, $2 per ton. These rates, which for an average haul of 809 miles are far below any railroad competition, are determined by the law of supply and demand, that is, the tonnage offered in relation to the commerce in sight. It is thus perfectly clear that the expenditure of $16,000,000 to the beginning of the present projects, for the improvement of interlake navigation, has been returned a hundred fold in direct benefit and saving to the American people.

On the Canadian side of the falls, the ship canal constructed by the Dominion Government from 1888 to 1895 is an important factor in lake commerce. It is 1¼ miles long, 150 feet wide, and 22 feet deep, with a lock 900 feet long, 60 feet wide, and has a depth of 20.3 feet at extreme low water level. It affords about 8 inches greater depth than the Poe lock, and for this reason nearly all the 500 and 600-foot ore ships now load for this lock. Of the average number of vessels passing the three locks each day, which in 1909-10 was 84, 27 were locked through the Canadian canal, and 57 through the American canal. The former carried 48 per cent of the total tonnage, although 94 per cent of the aggregate was freighted in American ships.

The first undertaking of the present projects, which have been under way since 1907, and will not be completed until about 1916, was the widening and deepening of the old canal above the locks, which involved an expenditure of $3,000,000. This work was completed late in 1910, and the new channel north of Bridge Island was used for the first time on the opening of navigation this year. The necessity of this improvement has long been felt by the vessel interests, as considerable delay and damage has been occasioned by passing vessels becoming jammed in the narrow channel of the swing bridge. Upbound vessels will take the north channel, while southbound craft will keep to the old passage south of the island.

The construction of the new channel was a work of some magnitude, the excavation being in shale and solid rock, and was done in the dry behind strong cofferdams. Beginning at a point near the north pier above the upper gates of the Poe lock, the excavation extended westerly to the head of the canal, which was extended to make the waterway 1 3/5 miles long. A new north pier was constructed of concrete along the north edge of the excavation, providing for a depth of 25 feet of water at extreme low level, and tapering from the point above the lock gates to increase the width of the canal from 130 feet at the bridge to 270 feet. This left the swing bridge span and the new movable dam in the middle of the canal, instead of on the old north pier. The new prism was then cleaned out, water was turned in, the old north pier was taken out, and the cofferdams removed. Dredging out the old channel to a uniform depth of 25 feet completed the enlargement. The canal is now 500 feet wide at the upper entrance, 270 feet at the basin, 108 feet at the lock gates, and 1,000 feet wide at the lower entrance.

As important as this improvement is to the lake shipping, the greatest project is the new canal with its mammoth locks. The chief advantage of a separate and free waterway constructed into the rapids lies in having at all times a uniform and dependable supply of water to feed the new locks, whereas, by taking the supply from the old enlarged canal, excessive currents would be roused. Experience has shown that when both the present locks are being filled at the same time, the drawing down of a great quantity of water in the upper canal creates strong currents at the bridge, which endangers vessels passing through the narrowed channels. And then, with one canal for all locks, in the event of the sinking of a ship or the wrecking of a lock gate, navigation would be entirely interrupted on the American side, while with independent canals, only two locks would be useless for the time being. The probability of such accidents occurring in both canals at the same time is very remote.

The new canal will be 260 to 300 feet wide, and will have a minimum depth of 25 feet at low-water level. Excavation of the prism through solid rock is progressing rapidly, and the building of the dyke for the water-power canal has been completed to a point opposite the power station in the rapids. The gates to connect the dyke with the station will soon be set up, and the new power canal put in commission during the summer of 1911. The filling of the new dump above the bridge with material excavated from the old and the new canals has been so extensive as to shut off a large flow of water through the Chandler-Dunbar canal, and it made necessary the new dyke, which extends well into the middle of the rapids. The extension of these engineering works into the rapids, which are in the nature of a dam, has the effect of preserving the normal level of the upper lake for the requirements of the lockages in the ship canals, but as a safeguard the amount of water which may be drawn through the power canals is regulated by the government, and is gaged by the fluctuations of the level of Lake Superior.

The new Davis lock, now under construction, will be 1,350 feet in length, 80 feet in width, and afford 24.5 feet depth at extreme low water datum. The usable length of 1,300 feet will pass in a single lockage two vessels, each 650 feet long, and 70 feet beam, leviathans which before long will be ploughing the inland seas, laden with 25,000 tons of iron ore in a single cargo. To transport this tonnage by rail would require 500 of the largest hopper cars, making 20 full trains nearly four miles long. The rail transportation, at the lowest rate which would show a profit, from the Lake Superior ports to Cleveland would cost about $63,000, yet the lake carrier delivers this tonnage on the Cleveland docks for $15,000, and earns a fair profit. So much for the economics of lake navi-

gation. The width of the new lock, 80 feet, will not pass vessels locked through abreast, but much time is lost in stowing by this method. In passing ships abreast in the Poe lock, which is 100 feet wide, the last one to pass in and the first one to go out must move very slowly and cautiously, or the mooring lines of the other will snap by the force of suction. As time is an all-important factor in the operation of the giant ore carriers, the new lock will gain more in quick passages than it loses in the number of vessels locked through. To expedite the passage of ships in the new canal, the bridge over the canal at the upper end will be of the bascule type, without a center pier, and will afford an unobstructed channel of practically uniform width throughout. Each leaf of the lift section will be 130 feet long, allowing a clear passage of 260 feet.

The third independent project, the work of deepening and widening the Middle Neebish channel in St. Mary's River, has progressed rapidly to completion, and the last section at Sailor's Encampment will be finished early in 1911. The improved channel is 300 feet in width, and has 22 feet of water over the rock bed at mean low stage level of Lake Huron. The improvement to the channels of this great highway of commerce still goes on to the ultimate deepening to 25 feet, which will greatly relieve the congestion of traffic of the two constantly passing processions, both night and day, of the splendid merchant marine.

## Mrs. Fleming

**By Annie J. Cannon, Harvard College Observatory**

THE name of Mrs. W. P. Fleming of the Harvard Observatory will always be intimately associated with the early history of the new astronomy. Born in Dundee, Scotland, in 1857, she came to this country about thirty years ago, and soon drifted into what was destined to become her life work by engaging upon some astronomical computations. But the time was ripe for new and remarkable methods of stellar investigations. The spectroscope had already begun to answer the long standing question of the ages as to what the stars are made of. The photographic plate was to constitute the next important aid in astronomical research. Experimental celestial photography had already been undertaken at Harvard, but not to any extent until 1882, when Prof. Edward C. Pickering, the present director, commenced his systematic patrol of the sky, which was greatly aided in 1886 by the generosity of Mrs. Draper in establishing the Henry Draper Memorial. In a short time photographs of the stars were being taken every clear night by Prof. Pickering's assistants, according to his plans. After development these photographs were placed in Mrs. Fleming's hands. Her aptitude for the work was at once apparent, and her ability to think quickly and clearly, proved invaluable in the organization and execution of this pioneer work.

A large number of the Harvard photographs are taken with a prism placed before the object glass of the telescope, so that the light of each star is spread out into a band, traversed by lines, dark or bright. With rare keenness of vision, and alertness of mind, Mrs. Fleming soon grasped the interpretation of these lines of light. Her strong individuality and absolute fearlessness were of special use in the early days when the new methods were ignored and often attacked by devotees of time-honored customs, when new stars were openly accused of being defects on the photographic film, and variable stars discovered photographically were sometimes omitted from the catalogues. But she never doubted herself. Day by day, year by year, with magnifying eye-piece in hand, she examined the photographic plates, marking any object that appeared to be peculiar, and superintending the confirmation of unusual objects, until our knowledge of the sidereal universe was greatly increased. Only two weeks ago, although under the shadow of the fatal illness, she worked with characteristic bravery on the proof of a volume of the annals entitled "Peculiar Spectra." This volume will give lists of the objects of interest found by her during all these years while examining the Harvard photographs. They include gaseous nebulæ stars having bright hydrogen lines, stars of the fifth type, variable stars and Novæ.

Her largest pieces of astronomical work were the "Draper Catalogue of Stellar Spectra" and a "Photographic Study of Variable Stars." The Draper catalogue, which contains 10,351 stars, was the first attempt to determine the constitution of large numbers of celestial objects. Nearly all of the three hundred variable stars she discovered were found in her regular examinations of the photographs by means of bright lines in their spectra. Ten new stars were also found in a similar manner. Her skill in administration was of great use in the numerous large pieces of routine work the observatory has carried through, and much of her time was spent on the proof of the numerous annals of the observatory. The value of her contribution to the progress of astronomy has been recognized in various ways. In 1897 the Harvard corporation gave her the official appointment of Curator of Astronomical Photographs, under which she had the responsibility of the care of the unique astronomical library containing over 200,000 photographic plates. In 1906 she was made a foreign associate of the British Royal Astronomical Society, and, shortly after, Wellesley College bestowed upon her an Honorary Fellowship in Astronomy. A few months ago the Astronomical Society of Mexico sent her a gold medal in honor of her discovery of new stars.

Although the greater part of Mrs. Fleming's life was spent in the routine of modern scientific work, yet the human element was never lost in the scientist. Her great love of flowers and of her home, as well as her unusual skill in the use of the needle, prove that a life given to science need not destroy the "eternal feminine." Many a dainty bag, exquisitely finished, or doll dressed in a complete Scotch Highland costume, went from her hands to friends far and near at the Christmas season. Because she was so intensely human, and brimming over with life, she won friends easily. No visitor to the observatory will ever forget the warmth of her greeting with its pleasing Scotch accent, the cheer of her laugh, or the personality of her sympathetic nature.

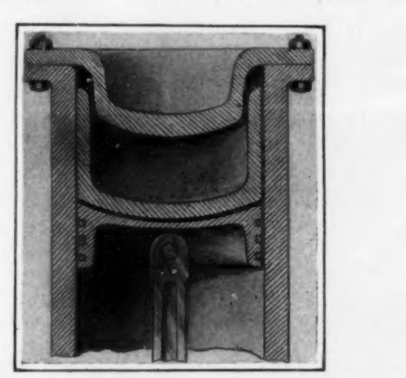
# Correspondence

## A Gas Engine Suggestion

To the Editor of the SCIENTIFIC AMERICAN:

With the object of increasing the power, or lowering the temperature, steam combined with the products of combustion has been experimented with in internal combustion engines.

Would you allow me space to outline a cycle in



**View of piston and cylinder head for proposed gas and steam motor.**

which a portion of the heat now wasted would be used to generate steam within the cylinder, producing an impulse of equal or greater power than that resulting from the combustion of the fuel, with which it would be alternate? I will refer to one as the steam, to the other as the gas impulse.

To attempt this I would propose to employ what might be compared to an inverted trunk piston, which would consist of two parts, rigidly attached, but insulated one from the other. One part would consist of a comparatively narrow piston, the other would form a cup open toward the cylinder head; the cup to be made of some alloy which, while a good conductor of heat, would withstand a high temperature; the central part of the cylinder head to be depressed, so that at the end of the stroke it would occupy more or less space within the cup; the proportion with regard to depth which one would bear to the other depending on the size of the combustion space required, which would be formed between them at the end of the stroke; the inlet and exhaust valves, the fuel and water spray nozzles to pass through the cylinder head.

When starting, the engine would be operated by the gas impulse alone until the cup had acquired a sufficiently high temperature, then, following the stroke which discharges the products of combustion, heated water under pressure would enter the cylinders, the object being to spray the entire unpolished, and possibly corrugated, inner surface of the cup, and produce saturated steam with extreme rapidity, the water bursting into steam of as high a temperature as it is possible to work with. If some of the spray were less fine than the rest, the formation of steam might be prolonged. Some heat would inevitably pass through the cylinder walls. By jacketing, a portion of this could be utilized to raise the temperature of the feed water to a point below 212 deg. F.; if too hot it would form steam too readily. It must enter the cylinder as hot as possible, but as *water*. When all the water had been vaporized, the steam would superheat while expanding for the remainder of the stroke.

The present four-cycle engine would become a six-cycle, the two a four, the latter that type of large engine in which the air is separately compressed. The valve-operating mechanism would be more complex, as while the exhaust valve might be timed to suit both impulses, the air and fuel for one impulse, and the water for the other, would require to be separately timed.

Possibly with separate compression the clearance between the cup and cylinder head might be less, the scavenging would then be more thorough, and the steam would attain a pressure with greater ease in the more confined space; the air being admitted for a portion of the stroke before combustion took place. A dangerous temperature within the cylinder might be detected by observing the temperature of the exhaust steam. All would enter the cylinder when the temperature of the cup was lowest.

The temperature of the exhaust steam, although superheated, would be much lower than that from the gas impulse; combined, they might be passed through a turbine.

Given three equal quantities of fuel oil, let one be burned beneath a boiler, the second within the cylinder of a gas engine—a Diesel engine, for instance—while the third is used in an alternating engine. If the type proved practicable, might it not be possible eventually to obtain power from the last, equal to the combined output of the two former? Steam generated and expanded within the cylinder might be used at a much higher temperature, and consequently pressure, than is now feasible, more than compensating for a slight loss which might be expected in the gas impulse.

The proportion of water to fuel to produce steam of a given temperature, whether the alternations could be obtained with sufficient rapidity, the mass of the cup and other points, could alone be determined by experiment. MOTOR.

Brentwood, Cal.

## How to Handle a Zeppelin

To the Editor of the SCIENTIFIC AMERICAN:

Reading this week of the disaster to another of the Zeppelin airships made me think of a plan by which such a disaster might be avoided. I am not an inventor nor a machinist, and the plan might not be worth consideration. I am going to offer it nevertheless.

It seems to me that a couple of hundred men hanging on to a rope is a mighty crude way of handling the ships. Why not have a heavy steel car with a strong motor, or more than one car, running on a track under the ship? If necessary to gain traction power, have a system of cogs that would prevent any backward motion under a heavy gust of wind, such as wrecked the ship the other day. If there would be danger of the ship lifting the car from the track, put a third rail between the other two tracks and lower. Reverse this third rail and have two wheels running on it and connected to the under side of the car. This would be the same principle used in the hanging electric car lines, only reversed. It ought to be a simple matter to arrange a system of connection between the car and the airship by means of which they could be disconnected in an instant.

As I said before, this is only a suggestion and may not be worth the paper it is written on, and if you think so, then destroy it. D. W. B.

Webster, S. D.

[The plan outlined is mentioned by Mr. Carl Dienstbach in last week's SCIENTIFIC AMERICAN.—ED.]

## Bacterial Lineage

THERE could hardly be a better example of the scientific spirit than the application of the methods of biometry to those excessively minute organisms, the bacteria. Experiments in this relation marked the beginning of a new era in bacteriological classification and nomenclature. There have been applied the methods used by anthropologists and students of variation and heredity to the definition of the species of bacteria. The results are, of course technical in their nature, and in themselves interesting only to students of the subject, but they have a broad general interest because they served to assure the public that advance on strictly scientific lines is being made in the study of those almost infinitesimal creatures that play so important a part in human life and everything that human life depends upon.

# The Heavens in June

## Our Monthly Astronomical Page

By Henry Norris Russell, Ph.D.

ON ANY clear evening at the present season, shortly after dark, the most casual observer cannot fail to notice two very brilliant objects surpassing all the stars, one in the southeast, the other, still brighter, in the northeast. If he is at all familiar with the heavens he will be able to identify these at once as Jupiter and Venus. The fact that they do not twinkle proves they are planets and not fixed stars. Mars alone, besides the planets mentioned, ever appears anything like so bright; but is red, and these are not.

It is equally easy to tell which is which without recourse to the almanac. The planet in the southeast, being apparently in the opposite part of the heavens from the Sun (now below the northwestern horizon) must really be outside the Earth's orbit; hence it must be Jupiter and not Venus. Even if both planets had been evening stars together, Venus could be distinguished at once, for she is almost invariably much the brighter of the two. Both are interesting telescopic objects, but there is a great difference in the satisfaction which they afford the observer.

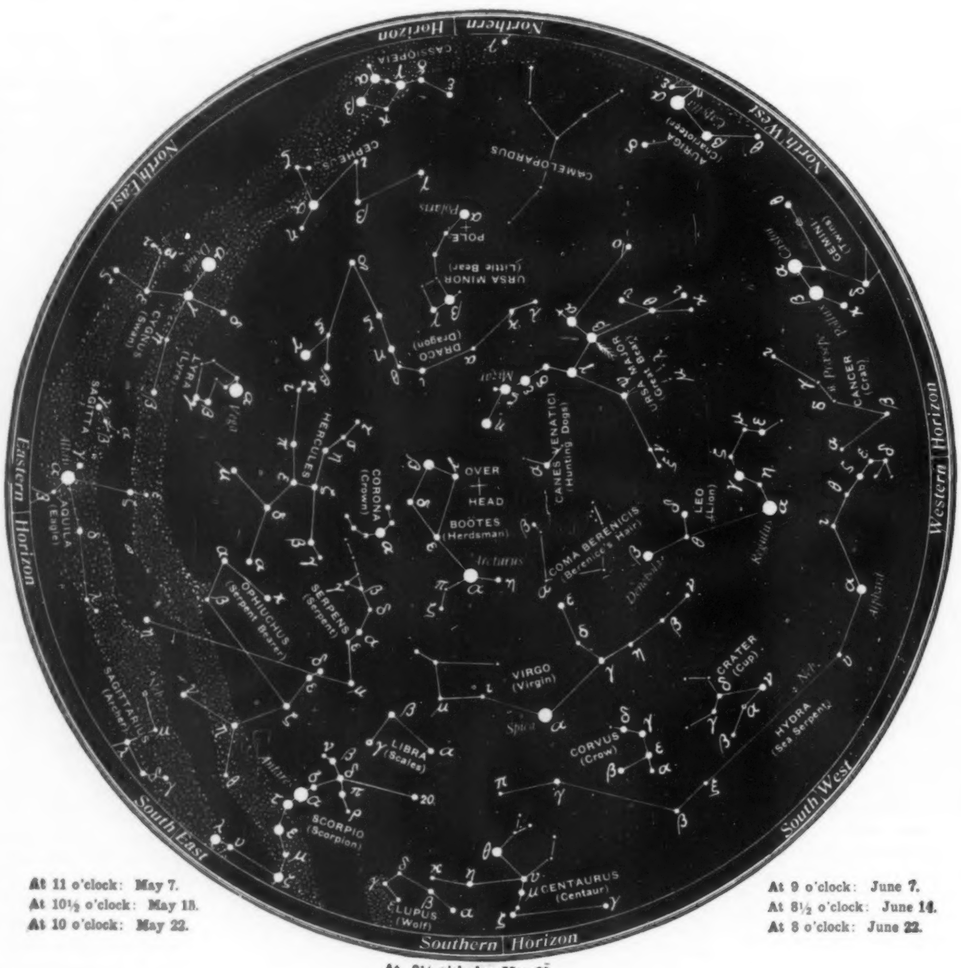
Jupiter, though now some 430,000,000 miles away, looks just about twice as big as Venus (when viewed with the same telescopic power) though the latter is only about 85,000,000 miles from us. Even at this five-fold greater distance, the former planet shows a wealth of surface detail. A very small instrument brings out the dark bands parallel to the equator, and a larger one shows many finer markings, which can be seen to move across the disk as the planet rotates.

Venus, on the other hand, is a most unsatisfactory telescopic object. Her great brightness and the beauty of her phases (which exactly resemble those of the Moon, and change in the same way) are very impressive to the novice; but one may look at her a hundred times and see no more. She appears as a uniformly white sphere, with illumination shading off conspicuously but gradually toward the phase limb, and not a trace of definite markings. Under favorable conditions vague and ill-defined darker shadings may be seen on the bright surface, but nothing at all comparable with the conspicuous markings shown by Mars or Jupiter or by the Moon to the unaided eye. Why should the brightest of the planets thus reveal so little of her true character to our scrutiny? In trying to find an answer, we must bring all the available evidence to bear on the case.

Measures of the light which we receive from Venus show that fully three-quarters of the light falling on her surface is sent back into space, as compared with about one-fourth for Mars, and only one-sixth in the case of the Moon.

The planet's surface is therefore remarkably white, as much so as white paper, or as clouds, or, almost, as snow. The last two substances seem to be the only ones which could actually cover a planet's surface so completely. But, since Venus gets twice as much light and heat from the Sun per square mile as we do on the Earth, permanent snow all over the surface seems out of the question, leaving us practically shut up to the belief that the visible surface consists of clouds. These might be clouds of condensed water vapor, like our own, or perhaps, as Lowell suggests, clouds of dust or haze in a dry atmosphere. That there is an atmosphere about the planet is proved beyond question by the twilight effects which are visible when Venus is almost in line between us and the Sun. All the evidence, however (as the writer pointed out some years ago), goes to show that the extent of this atmosphere, *above the visible surface*, is much less than that of the Earth's above sea level; though not perhaps less than that of our atmosphere above the highest clouds.

When we come to inquire whether clouds like those which we know so well could cover the whole surface of Venus, the rate of her rotation is of great importance to our answer.




At 11 o'clock: May 7.
At 10½ o'clock: May 15.
At 10 o'clock: May 22.
At 9½ o'clock: May 30.
At 9 o'clock: June 7.
At 8½ o'clock: June 14.
At 8 o'clock: June 22.

NIGHT SKY: MAY AND JUNE

It used to be believed that like the Earth, she rotated in about a day; but in this case she should be flattened at the poles, and the very accurate measures made during her transits across the Sun show her disk to be apparently perfectly circular. Moreover, spectroscopic observations, at the Lowell Observatory, which would detect rotation by the fact that one side of the planet was coming toward us and the other receding, indicate that the rate of this motion must be exceedingly slow, very much slower than in the case of Mars, for which the method gave a value within five per cent of that known to be correct.

Neither of these lines of evidence shows that Venus does not rotate at all; the observations would be explained by any period of rotation more than two or three months long. They suggest, however, without proving, that, like Mercury, Venus keeps the same side always toward the Sun. (The observations of markings on the surface, made some years ago at the Lowell Observatory, which would indicate that this was the case, do not appear to have been confirmed.)

A recent paper by the English meteorologist Clayden describes in a very interesting way the influence of rotation on the distribution of clouds on the planet.

Venus, being very nearly of the same size and mass as the earth, may fairly be compared with the latter. If her rotation was equally rapid, we would expect to find a cloudy region near the equator (varying in position with the seasons), relatively clear belts on each side, and then again more cloudy regions, with great patches of white (as seen from above) where below the weather was stormy. There is no question, says Clayden, that the Earth, seen from a distance, would appear as "a belted planet," with the clouds by far the most conspicuous feature.

That Venus shows nothing of the sort is another proof that her rotation cannot be rapid.

On the other hand, if she kept one side always toward the Sun, the other would become intensely cold, and all the water would be frozen up there. The sunward side of the planet would be a vast desert, over which it is very unlikely that clouds would form.

This is Lowell's belief, which he supplements by supposing that the atmosphere above this desert is so dusty that it reflects almost as much light as clouds would do.

Clayden favors the alternative belief that the planet's rotation, though slow, is more rapid than the orbital revolution, so that an observer on its surface would have regular alternations of day and night, but at relatively long intervals, which he estimates might be anywhere between twenty and two hundred of our days.

Under these conditions the water would not be permanently frozen on one side of the planet, oceans might exist, and hence there might be plenty of evaporation to furnish clouds.

Working out the atmospheric calculation, he deduces that the hottest part of the planet would be an oval area where the Sun was nearly overhead or a little past noon. In this region rising currents of air would bring up great quantities of moisture, and form dense clouds.

Surrounding this in a sort of irregular ring would be a region of descending currents of air, where the clouds would be thinner, and we might perhaps see bits of the surface through them. Beyond this again they should grow denser, as far as the sunlight reached. On the dark side of the planet the sky might be partly clear. Far above these clouds, which might resemble our cumulus or "thunder heads," would be thin filmy cirrus clouds, which would contribute their share to the reflected light.

This theory, of which only a brief sketch is given here, seems to the writer the most satisfactory one so far brought forward. It is interesting, though of course purely speculative, to consider that, if this explanation is correct, the real surface of Venus may be composed of land and water like the Earth's; and, under the protecting screen of clouds, life might be possible under conditions much like those familiar to us, but these very clouds would screen it forever from out observation.

### THE HEAVENS.

With the aid of our map the principal constellations can easily be identified. Due south, and high toward the zenith, is Boötes, marked by the great red star Arcturus.

Below, on the right, is the fainter white star Spica, in Virgo, and on the left the very bright planet Jupiter. Far below, on the southern horizon, are the

(Continued on page 556.)


[The Editor of the Home Laboratory will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

## A Twenty-five-cent Photographic Objective

**By Gustave Michaud, Costa Rica State College**

SOME amateur photographers take nothing but snapshots, while others, because they aim, above all, at technical perfection and have no use for underexposed negatives, take nothing but time exposures. Amateurs of the first category need not read the following lines, as the objective described here would be, in most cases, too slow for them. It requires 1 second to perform work which would be done in 1/15 of a second by an anastigmat used at full aperture. As a compensation, when made to cover the whole plate as sharply as the anastigmat does, it has over the costly objective the following points of superiority:

1st. A better rendering of color. The blue sky is not made just as luminous as the white clouds. Red cheeks are not made to appear as black depressions.

2nd. A greater depth of focus. The small aperture gives a better definition of any object out of focus.

3rd. A more uniform illumination of the field. The margin of the plate is not darker than the center. This again is a result of the smaller aperture.

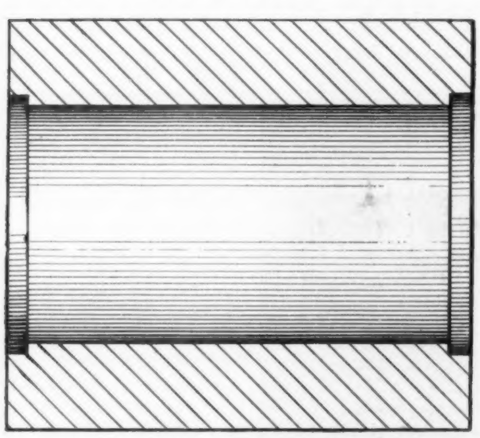


**Fig. 1.—Longitudinal section of objective tube.**

4th. A lower price. Twenty-five cents and some easy work is about the price paid for the home-made objective. Twenty-five dollars is about the price of an anastigmat covering a 5x7 plate or of a good rectilinear combination covering an 8x10 plate.

The home-made objective is composed of two parts: the refracting combination contained in a wooden tube placed, as usual, in front of the camera; and the screen, placed behind the lenses and close to the sensitized plate.

The refracting combination is made of two circular, periscopic, spectacle lenses, separated by a diaphragm. Such a combination, has over a single lens, the advantage of a complete elimination of the distortion, together with a considerable reduction of the spherical aberration and of the curvature of the focal surface.

The screen confers to the objective the qualities of being, to some extent, achromatic and orthochromatic, qualities which are incompatible from the etymological, not from the optical point of view. The screen is dyed with ammonium picrate, a yellow substance which effectively stops most of the ultra-violet and violet rays, and so weakens the blue that this color has not much more action on the plate than the less actinic green and yellow rays.

The needed material for the making of an objective which will sharply cover the 5x7 plate consists of two periscopic convex, two diopter, spectacle lenses, X or test lens shape (price, 15 cents the pair, sold by all manufacturing opticians), and a parallelopiped of seasoned hard wood, 2¾x2¾x2¾ inches. A hole same diameter as lens, that is about 1½ inches, and about ¼ inch deep, is drilled in each square end of the parallelopiped. Then a 1¾-inch auger bit is substituted for the 1½-inch bit and the hole is drilled throughout the block, the longitudinal section of which will then be as shown in Fig. 1. While drilling the counterbore as well as the main bore, the utmost care should be taken to keep the auger bit at right angles with the surface. The block is then sawed transversely through its central part until the saw has passed clear through the hole, but not much farther. Two wooden strips are screwed on the sides of the block. They close laterally the cleft made by the saw and leave it open only on the top of the parallelopiped. Through this upper opening the diaphragms are introduced and removed. There should be at least three of them, with openings ½, 5/16, 3/16

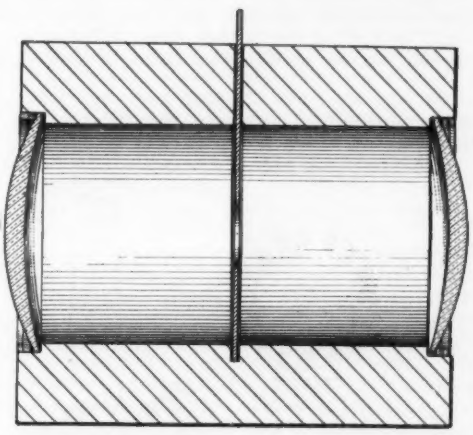


**Fig. 2.—Sectional view of the completed objective.**

of an inch in diameter, approximately corresponding to 1/20, 1/32, and 1/64 of the focal distance. They can be made of black pasteboard or of metal. No diaphragm should be used while focusing.

After the inside of the objective tube has been blackened with drawing ink the two lenses are placed as shown on Fig. 2, with their concavity facing the diaphragm. A ring of pasteboard or of wire keeps them in place and allows of easily removing them when they must be cleansed. The shutter is a cover made of black pasteboard. A hole 1¾ inches in diameter is drilled into the center of a board about 4x4 inches, which is afterward fastened upon the objective tube in the manner shown on Fig. 3. Four screw holes are drilled on the four corners of this board. The objective can now be screwed in two minutes upon any 5x7 camera.

To make the screen, two of the 5x7 sensitized plates are immersed into the ordinary fixing bath of hypo until the white bromide of silver has entirely disappeared. This operation is made in the darkroom, far away from the ruby light. A thorough washing (fifteen minutes at least) in running water follows. The two plates are then left, film upward, for about five minutes in the following solution: Water, 250 cubic centimeters; picric acid, 2 grammes; ammonia, 10 cubic centimeters.

Next, they are immersed for not more than two seconds in water and are allowed to dry away from dust. When perfectly dry, they are bound together, film against film, with simple syrupy shellac varnish. The liquid is rapidly poured over both films; the plates are then firmly pressed against each other to drive away air bubbles. A few days later the glass is cleansed and the edges are finished with black *passe partout* binding.

In most cameras the screen can be effectively and permanently kept in place by means of four thumbtacks nailed on the inside part of the frame which carries the ground glass and its spring. The screen will then be almost in contact with the sensitized plates.

If the home-made objective is intended to cover the 8x10 plate, the following alterations must be made in the figures given for the 5x7 plate: The objective tube should be long enough to allow of a distance of 4 inches between the two lenses. These should be 1.25 diopter lenses. Finally, the diaphragm apertures should be ¾, ½ and ¼ of an inch, to correspond to 1/20, 1/32 and 1/64 of the focal distance.

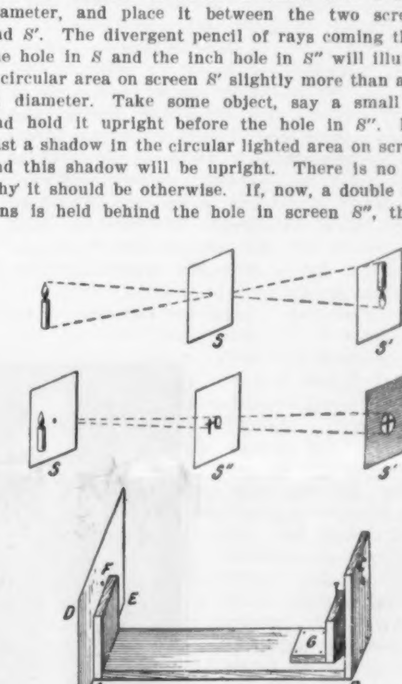
**Fig. 3.—General view of the 25-cent objective.**

## An Experimental Proof of Inverted Retinal Images

**By A. H. Patterson**

IT is usually somewhat mystifying to be told that all upright objects, such as trees, men walking, etc., form inverted or upside-down images on the retina of the eye. However, it is easy to construct a simple bit of apparatus which will prove the point in question. But first we must understand clearly one or two principles of the action of light rays.

Take a sheet of cardboard *S* and pierce in it a small hole about one-tenth of an inch in diameter. In front of it place a lighted candle, and behind it a cardboard screen *S'*. On this latter screen will be seen an inverted image of the candle—a so-called "pin-hole image." Now place the candle quite close to the screen *S* and let its light shine through the small hole upon the screen *S'*. Then take a third cardboard screen *S''*, from the middle of which is cut a hole 1 inch in diameter, and place it between the two screens *S* and *S'*. The divergent pencil of rays coming through the hole in *S* and the inch hole in *S''* will illuminate a circular area on screen *S'* slightly more than an inch in diameter. Take some object, say a small cross, and hold it upright before the hole in *S''*. It will cast a shadow in the circular lighted area on screen *S'*, and this shadow will be upright. There is no reason why it should be otherwise. If, now, a double convex lens is held behind the hole in screen *S''*, the size




**Experimental proof of inverted retinal images.**

of the lighted area and the cruciform shadow on *S'* will be altered, but the shadow will still be upright.

Now for our experiment. Construct of thin pieces of wood a frame like that shown in the drawing. The distance *AB* is about 7 inches; the hole *C* is about one-tenth of an inch in diameter, and *DE* is a piece of white letter paper about 4 inches square, pasted over the wooden upright at the left. At *F* a tiny hole is pierced through the paper with an ordinary pin. Now stick a pin upright in the block *G* and adjust the position of the block so that the head of the pin is exactly in line between the holes *C* and *F*, and three-fourths of an inch from the hole *C*. Fix the block *G* in this position. This completes our apparatus. Placing the eye close to the hole *C* and looking through hole *F* at the sky, we see a lighted circular area with the shadow of the pinhead in its center, but *this shadow is inverted.* We are ready to declare that the pin is upside down, for it certainly looks so. When we reflect a moment, however, we see that we have now exactly the same arrangement as in the middle diagram. The hole *F* represents the hole in the screen *S*, the pinhead represents the cross, the pupil of the eye represents the hole in screen *S''*, and the retina of the eye takes the place of screen S' and receives the upright shadow of the pin head upon it. The crystalline lens of the eye acts precisely like the lens in Fig. 2, altering the size of the retinal shadow, but not its upright position. This upright shadow on the retina, however, makes us think that the object throwing it is inverted, for the shadow certainly "looks" inverted to us. But we know that the object throwing the shadow is upright, and it follows in consequence that the retinal images of upright objects are inverted. In using this apparatus the eye must not be focussed on the pin, or the hole *F*, but on something distant, like the clouds or the twigs of trees between the observer and the sky.

# Abstracts from Current Periodicals

## Phases of Science as Other Editors See Them

### A Smoke Dissipating Chimney

THE age of hygiene and applied science has developed a problem of gaseous sewage, as well as one of aqueous sewage. The production of a good draft is no longer the sole or even the principal function of a factory chimney, and is of comparatively little importance in many industries, in which forced draft is largely employed.

Great improvements must be made in factory chimneys and other sources of smoke and noxious gases before the continual complaints and law suits provoked by these nuisances can be expected to cease. Manufacturers and foresters, governmental authorities and experts are seeking contrivances and methods by which these products can be made harmless, or less harmful, without prohibitive expense.

The greatest success may be expected from apparatus operating automatically through natural agencies without human intervention. Hitherto, reliance has been placed almost wholly on very lofty chimneys. Until recently the tallest in existence was the Halsbrueck chimney, near Freiberg, in Saxony, which is 459 feet high. In 1909 a slightly higher and much larger chimney was erected by the Copper Mining Company of Massachusetts, and other American smelting companies are preparing to follow the example. Chimneys exceeding 150 feet in height are now very common, and a height of 300 feet is not rare. The practical limit of height has already been exceeded, for very tall chimneys not only are inordinately costly, but they utterly fail to serve the hygienic purpose for which they are designed.

In order to make furnace gas innocuous to animal and vegetable life by simple dilution with air, the mixture must be produced very quickly by eddy currents at the mouth of the chimney, or, preferably, inside the chimney, but the higher atmospheric strata which are pierced by very tall chimneys are notably free from the eddies which are produced in lower strata by convection from the warm soil and by hills, trees, buildings and other obstacles.

Some of the sulphur dioxide and other injurious constituents of smoke and gaseous waste products can be removed by passing the gases through water, lime and other chemical agents, but it is economically impracticable to make the gases entirely innocuous to health, and especially to vegetation, by this method. The small proportion of sulphur dioxide contained in the air of Berlin (from 3 to 5 parts in one million) is sufficient to stunt the growth of the conifers in the city parks. From this and other evidence it is certain that ordinary chimney gas must be diluted with at least 100 times its volume of air in order to become harmless to vegetation.

Dilution to this extent is not effected by the wind as rapidly as is commonly assumed. Steamships often leave trails of dense smoke which extend for many miles. Usually the smoke is quickly diluted to a considerable degree immediately on emerging from the chimney, but the process of dilution goes on very slowly after the smoke has attained the velocity and direction of the wind. In an article in *Die Umschau*, Prof. H. Wislicenus describes a new type of chimney which he has invented and patented, and which accomplishes rapid dilution of the furnace gases in the simplest manner, without chemical, mechanical or human aid

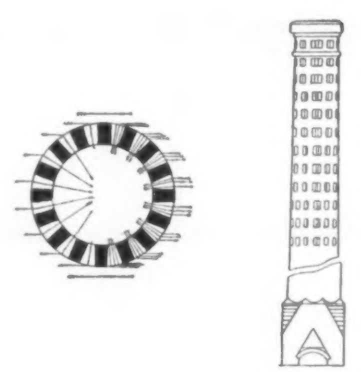


**Fig. 1.—Plan and elevation of the dissipator chimney.**

or an increase in operating expenses. In the "dissipator," as the new chimney is called by its inventor, the smoke and gases, instead of issuing in a compact stream from a single mouth at the top, are distributed among a number of nearly horizontal channels terminating in orifices in the side of the chimney, and are mixed with air, both before and after emergence, by the eddy-forming action of the wind, without lessening the force of the draft.

The upper part of the dissipator chimney (Fig. 1) is perforated by numerous horizontal channels which have the shape of funnels, with their small ends directed inward. Hence a wind blowing in any direction streams through the chimney and becomes intimately mixed with the hot gases and smoke which rise from the unperforated part of the chimney below. Some of the smoke escapes, only slightly diluted with air, from the lowest openings, but the greater part of it continues to rise and to escape gradually in more and more diluted form. The formation of eddies both inside and outside the chimney is promoted by the tapering form of the channels and the diversity of their directions. The result is that scarcely any smoke is visible in strong winds, and even in light winds dense smoke is seen only in the immediate vicinity of the lowest openings (Fig. 2). The perforations occupy one-third or one-fourth of the total height of the chimney. The unperforated lower part is carried to the height required to produce the desired draft, if natural draft is used.

The form and dimensions of the channels can be modified in various ways to increase the dissipating action. On the other hand, the efficiency of the device may be seriously impaired by unskilled construction, as is shown by the dense cloud of smoke emitted by chimneys constructed with a single tier of high vertical slits instead of three tiers of smaller orifices. The top of such a chimney may be closed or left open, without affecting the draft in the least.

Several large chimneys of this type are already in use. With one of these an experiment was made by using fuel which produced a great deal of smoke. The result was a remarkable sheet of dark blue smoke waving like a flag on the leeward side of the chimney, but extending only to a distance of 40 to 60 feet, while an ordinary chimney, in these circumstances, would have emitted a column of smoke a mile long.

When forced draft is employed, the dissipating action may be increased by building several low perforated chimneys, one within the other. A "multi-dissipator" of this construction, shown in Fig. 4, has proved very satisfactory in a large German dyeing and bleaching establishment.

The principle on which the dissipator chimney is based—the rapid commingling of gases or liquids by the mechanical agency of variously directed currents—can be applied to the diffusion of sewage in streams, the abatement of the smoke of automobiles, and many other purposes.

The chimney pouring forth a long column of dense smoke, which adorns so many advertisements of factories, is not an emblem to be regarded with pride.

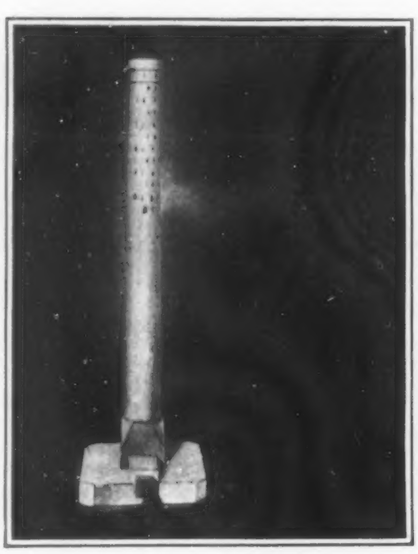


**Fig. 2.—A properly constructed dissipator chimney.**

**Fig. 3.—Analyzing the smoke and gases.**

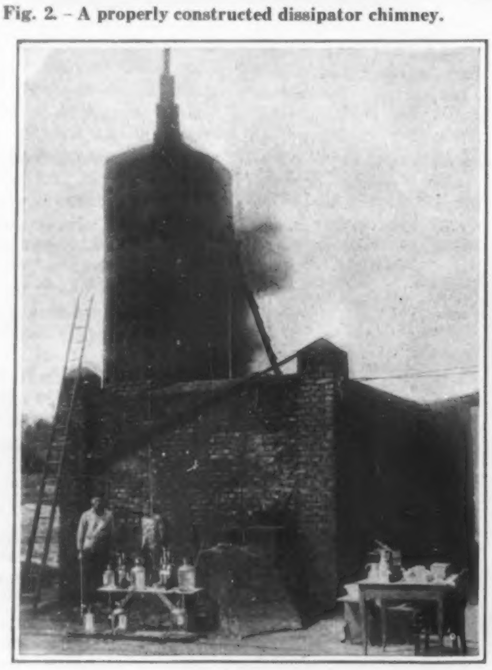


**Fig. 4.—A "multi-dissipator" chimney.**

**Fig. 5.—Another view of the "multi-dissipator" chimney.**

A SMOKE DISSIPATING CHIMNEY

### Wind Furnaces

ONE of the earliest devices for burning coal was a small furnace made of sheet iron, in the form of a drinking horn, which was called a wind furnace. A grate, placed a short distance

below the mouth of the horn, was covered with small pieces of wood and fine coal. The theory of the apparatus was that its peculiar form would create such a draft through the small open end of the horn that the fuel will be completely consumed. As the wind furnace was portable and was not connected with a chimney, the inadequacy of this theory was soon proved by practice.

A model of the medieval wind furnace will be shown at the coming International Hygienic Exhibition at Dresden, as a part of a collection illustrating the development of the hearth and furnace from the Stone Age to the middle of the 19th century. According to *Hygieia*, the journal of the exhibition, an experiment made with this model resulted in the production of dense and stifling smoke. The wind furnace made it possible to burn mineral coal, but this was its only superiority over the ancient charcoal brazier, which was its prototype.

## A Radium Inhaler

It has often been observed that bottled mineral waters are less efficient in the treatment of certain diseases than the same waters drunk at the spring. It is known, also, that most mineral waters are more or less strongly impregnated with volatile radium emanation, which escapes and decomposes before and after bottling. These facts led Dr. A. Bickel, in 1905, to try the remedial effect of water artificially impregnated with radium emanation obtained from radium bromide. This water was employed with success in some diseases of the stomach and intestines, in gout, rheumatism and neuralgia, and in some cases of cancer in which operations were inadmissible. At first the water was administered only by the stomach, but it was subsequently employed in the form of baths also. From the latter use the inhalation treatment naturally developed, as the bather necessarily inhaled the emanation which rose from the water and mingled with the air.

In an article in *Die Umschau*, the substance of which is here presented, Dr. Bickel states that when water impregnated with radium emanation is administered internally the emanation remains longer in the system, and therefore produces more effect, if the water is taken after a full meal, than if it is taken on an empty stomach. In rheumatic and arthritic affections the remedial action of the water, thus administered, is greatly corroborated by baths, in which the bather finds opportunity for exercise, which is beneficial in itself and also accelerates the evolution and inhalation of the radium emanation which the bath contains.

The only objection to the pure inhalation treatment, as it has hitherto been applied, is the necessity of confining several patients together for an hour or several hours daily in an "emanatorium," or closed room, the air of which has been impregnated with radium emanation. The room cannot be ventilated without wasting the precious emanation, and, although oxygen is continuously supplied and carbon dioxide absorbed, the atmosphere becomes unpleasantly and even injuriously contaminated.

Dr. Bickel has recently devised a portable apparatus for the continuous evolution and inhalation of radium emanation, which enables the patient to take the inhalation treatment at home. As the accompanying illustration shows, the patient inhales air from a large bottle *b*, into which water containing radium emanation falls in drops from a smaller bottle *a*, through a valve by which the flow can be regulated. The inhalation mask is so constructed that the patient can exhale either directly into the air of the room or into a third bottle *c*, the air in which contains the same percentage of emanation as the air in *b*, thus reproducing exactly the conditions of the "emanatorium," in regard to emanation pressure.

Except in special cases, Dr. Bickel recommends the administration of radium emanation through the stomach and the lungs conjointly, and he adds the bath treatment in some cases, as indicated above. When the baths are omitted, he prescribes a glass of strong emanation water, taken after a hearty breakfast, and followed immediately by one or two hours' inhalation with the apparatus described.

## Common Defects in Metal Alloys*

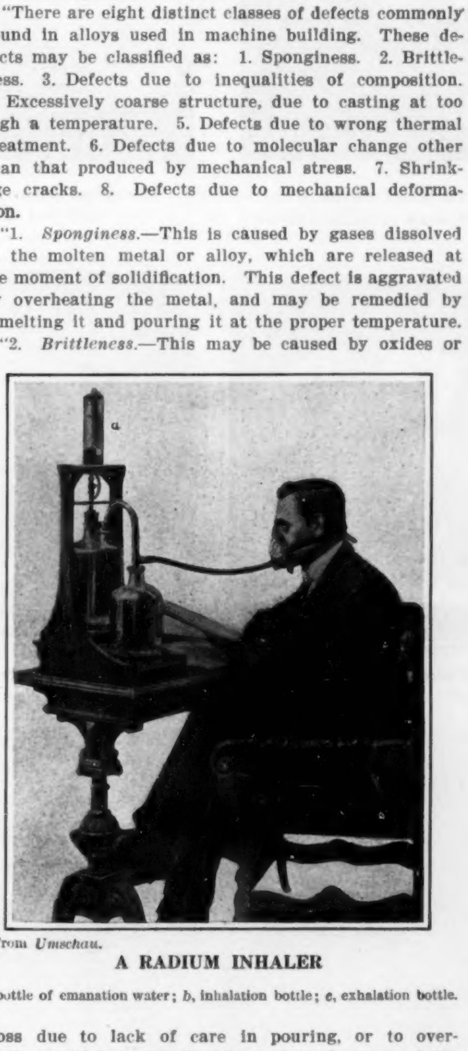
The knowledge of the properties of non-ferrous metals and alloys has not developed as fast as that of iron and steel. Several causes have contributed to produce this condition. The number of industrial metals and alloys is so large, and their characteristic properties so diversified, that conclusions arrived at from a study of one group would be of little or no value when applied to another. A consideration of the several defects which occur in commercial alloys of all kinds forms the subject of a paper read by Dr. C. H. Desch before the Institute of Metals. In view of the very considerable interest of the subject, we reproduce here Dr. Desch's words:

"Many difficulties are met with when using alloys in practice. Some of these are inherent, but some could be avoided by careful treatment. It frequently happens that a perfectly satisfactory alloy fails because of being subjected to entirely unreasonable heat treatment or to mechanical stresses, in the course of being fitted for use. Such treatment is applied in ignorance of the effect likely to be produced, but considering the care that is taken in handling steel, it is remarkable that non-ferrous alloys are often treated as if they were mere inert material, which might be ill-treated without suffering any injury. For instance, while no user of metals would quench steel from high temperature or submit it to prolonged annealing without reference to the purpose for which it was to be used, it is not an uncommon experience to find bronzes made for special purposes treated in such a way.

"There are eight distinct classes of defects commonly found in alloys used in machine building. These defects may be classified as: 1. Sponginess. 2. Brittleness. 3. Defects due to inequalities of composition. 4. Excessively coarse structure, due to casting at too high a temperature. 5. Defects due to wrong thermal treatment. 6. Defects due to molecular change other than that produced by mechanical stress. 7. Shrinkage cracks. 8. Defects due to mechanical deformation.

"1. *Sponginess.*—This is caused by gases dissolved in the molten metal or alloy, which are released at the moment of solidification. This defect is aggravated by overheating the metal, and may be remedied by remelting it and pouring it at the proper temperature.

"2. *Brittleness.*—This may be caused by oxides or




From *Umschau*.

**A RADIUM INHALER**

*a*, bottle of emanation water; *b*, inhalation bottle; *c*, exhalation bottle.

dross due to lack of care in pouring, or to overheating, which causes burning, as in the case of the zinc alloys. The oxides of different metals vary as to their ability to separate themselves from the liquid and rise to the surface, and various deoxidizers are used to facilitate their removal in the form of slag. A second source of brittleness is the presence of thin layers of non-homogeneous alloys between the crystals. The microscope is of great assistance in studying cases of this kind.

"3. *Defects due to inequalities of composition.*—These defects are due either to improper mixing of the ingredients, to separation by gravity during solidification, or to segregation in the mold. When the ingredients are not uniformly mixed, the usual cause is the difference in specific gravity of the ingredients. Aluminium, for example, tends to float, and lead to sink. Certain metals, particularly aluminium, also possess the property of becoming inclosed in a film of oxide as soon as in the molten state, while others have an action similar to that of oil and water and must be stirred to an emulsion and then carefully cooled to prevent separation. With alloys of tin and antimony, or mixtures containing them, a difficulty is met with in that crystals of tin and antimony form and float upward. This tendency is overcome by rapid chilling. Impurities in general, such as lead and bismuth in bronzes, will accumulate at the center of the parts and cause unsound castings.

"4. *Excessively coarse structure due to casting at too high a temperature.*—As the strength of an alloy depends upon the degree of adhesion between neighboring crystals, as well as upon their size, and as these qualities in turn depend on the casting temperature and the degree of chilling, this becomes a complex question that requires much further investigation. A few alloys containing copper and zinc, and especially those rich in zinc, have an extraordinary tendency to form large crystals having little mutual adhesion.

"5. *Defects due to wrong thermal treatment.*—These defects are due to a number of causes, as, for instance, to quenching from too high a temperature; heating at too high a temperature or too long during annealing; burning, as in the case of copper and zinc alloys; and unequal thermal treatment of different parts of the same casting and forging. The principal effect of wrong thermal treatment is the production of coarse structure in alloys in general, and a hard, brittle metal in most bronzes. Unequal treatment also produces differences in the structure in different parts of the alloys.

"6. *Defects due to molecular changes other than those produced by mechanical stresses.*—Some metals undergo changes at definite temperatures which involve a complete alteration of their properties. The most striking instance is that of tin, which may pass spontaneously into a gray powdery substance devoid of mechanical strength, at a low temperature. Many alloys have been known to disintegrate spontaneously from no known cause. Some of the alloys of aluminium with other metals fall to powder after a time, while an alloy of 80 per cent of aluminium and 20 per cent of tin breaks up into coarse crystals. It may be that these phenomena are due to impurities in the constituents. This is indicated by the behavior of alloys of copper and manganese which have been described as disintegrating spontaneously. When prepared from pure metals, however, these alloys are permanent, and the disintegration is entirely due to the presence of non-metallic impurities.

"7. *Shrinkage cracks.*—These may be due to a poor arrangement of the mold, to wrong casting temperature and to the great brittleness of the alloy at a temperature just below that of solidification. The latter condition is the cause of the great tendency of aluminium zinc castings to crack during cooling.

"8. *Defects due to molecular changes produced by mechanical deformation.*—These defects show themselves as brittleness in cold worked metals; 'season-cracks' in brass and other alloys which become visible some time after rolling; and 'fire-cracks,' which differ from the foregoing only in that they appear during the annealing process alone. It is said that fire-cracks never appear in pure metals, but always in alloys. German silver is particularly liable to this defect. 'Chilling-cracks' are produced when metals are suddenly quenched. Cracking is also due to hot working, as most alloys show an increased brittleness at some particular temperature. Many bronzes have only a small range of temperature within which they may be safely worked. This subject has as yet been but imperfectly investigated.

There are some defects which do not fall under any one of the above heads. These defects are due to corrosion and erosion. The question of corrosion is now being investigated by a committee of the Institute of Metals (Great Britain). The conditions which affect the liability of alloys to mechanical erosion also demand further study. An interesting case of erosion is that of high-speed propellers acted upon by eddy currents in the water. In some cases the propeller blades are eroded to a depth of as much as 1½ inches in the middle of a blade, while the remainder of the blade is perfect. It appears that different bronzes behave very differently in regard to this action. A definite relation between the microscopic structure and the liability to erosion yet remains to be established."

## Magneton: A New Constituent of Matter

Electricity, which at one time was assumed to be a wave motion in the ether, is now regarded as a substance made up of atoms, or electrons, which exist in the atoms of all kinds of matter, and in a sense constitute the primordial elements of which all matter is composed. This view, suggested by the fact that the smallest quantity of electricity that can be measured (the quantity carried by a hydrogen atom in electrolysis) is always the same, is confirmed by the results of experiments in radio-activity. This elementary quantity of electricity is called an electron. The same tendency toward the materialization of energetic concepts is shown in recent attempts to establish an atom of light, and the process is now being extended to magnetism. Pierre Weiss has submitted to the Paris Academy of Sciences an essay, in which he attempts to prove, from the results of experiments on the magnetization of various elements at extremely low temperatures, that the atoms of iron, nickel, copper, manganese and uranium contain definite quantities of an elementary magnetic substance, to which the name "magneton" is given.

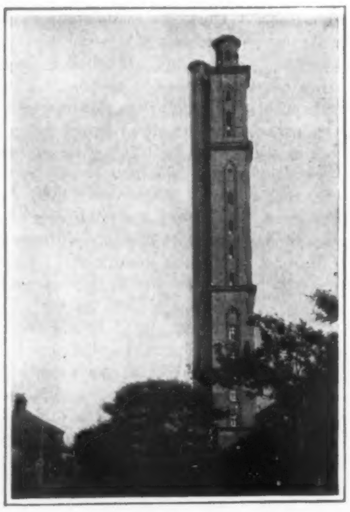
* Paper read by Dr. C. H. Desch before the Glasgow meeting of the Institute of Metals.

# Curiosities of Science and Invention

## A Maori Warrior on Jade

THE New South Sea Island Hall which has recently been opened to the public at the Museum of Natural History, New York, contains one of the largest and most varied collections from the South Seas probably yet seen in this country. These specimens represent the ethnology, material culture, ceremonials, household arts, war clubs, weapons, implements of hunting and fishing, etc., as used by the native inhabitants. The Fijian collection, numbering over 2,000 objects, is especially noteworthy and was presented as a gift by Mrs. Morris K. Jesup. One of the striking features of the exhibit is a unique statue representing a dancing Maori posed on the largest boulder of jade in the world; the stone weighs 7,000 pounds. It came from West Island, New Zealand, and was presented to the Museum by Mr. J. Pierpont Morgan. The statue was executed by Mr. Sigurd Neandross, and was cast entire from a living Maori, the model being sprayed with paraffin, and plaster applied afterward to strengthen it. This is less painful than the old plaster process, and the entire head and body can be taken at one cast. The coloring was done from life, and the tattooing on the face and hips was copied from a series of tattooed heads forming a part of the New Zealand Exhibit. While performing a dance the Maori man must follow the traditional code handed down from his fighting ancestors, which demands a constant thrusting out of the tongue accompanied by the greatest possible distortion of features. The farther the tongue is protruded, the more terrible and dangerous is the man supposed to be to all foes. The Maori is pictured beating time to the dance by striking the palm of the hand against the thigh and brandishing aloft the favorite war weapon, the "mere."

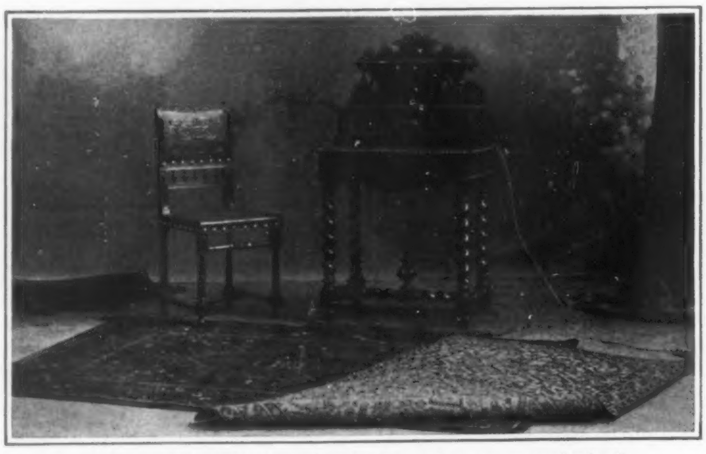
Statue of a Maori warrior at the American Museum of Natural History.



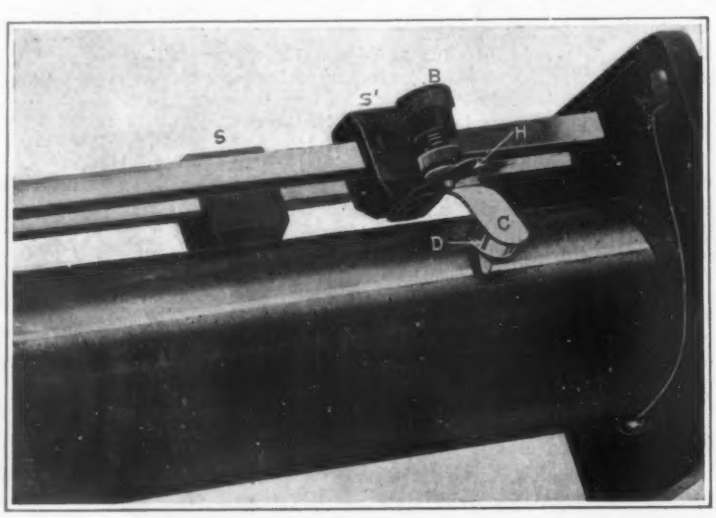
The tallest tomb in England 300 feet high.

Coverlet kept warm electrically.

Electro-thermic pads for the bed.



Rugs woven with electro-thermic threads to give a warm underfooting.




A combined tuner and detector for wireless telegraphy.

## Electrically-heated Fabrics

THE idea of using an electric heating wire in connection with flexible material is not new, but as far as we are aware, it has been used with asbestos fabrics only. Such fabrics are intended particularly for high temperatures. They are naturally of coarse grain, and were not very manageable electrically, and were also wanting in flexibility.

An inventor has recently hit upon a method of electrically heating carpets, coverlets, knitted fabrics and the like, made of wool or other threads, so that the presence of electric wires is not betrayed. The wires are energized by a flexible cord attachment to a lamp socket. It is during the weaving process that the textile threads and the electric wires are put into the fabric together, and they go to make it up in such a way as to preserve the usual appearance and suppleness of the tissues. A central wool thread is used around which a flat braided metal card is wound spirally. The flat braid is made up of very fine nickel wires, and after it is wound on the core thread, the whole is given an outer braiding of wool or other threads. Thus a very flexible thread is formed which does not buckle when it is woven. The metal thread has a large heating surface in proportion to its section. The great number of electro-thermic wefts composing a circuit permits of having between two neighboring wefts a difference of less than one volt, and the fabric is arranged so that there is no danger of short-circuiting in this way, and there is nothing to be feared in using the fabrics. The selvage is not made with heating wires in order to avoid bringing the metal near the borders where it might become rubbed. Collector wires for the current are placed in the selvages, and it only remains to attach a small connection plug and a flexible wire, which can be inserted by a plug in a wall socket as usual. Pure nickel is found the best wire to use, as when overheated its electric resistance at once rises and cuts down the current, so that an automatic regulating action is given which prevents overheating.

## The Tallest Tomb in England

NEAR the well known seaport of Southampton, England, there is a remarkable edifice known as Petersen's Tower. The erection is all the more singular because it marks the burying place of a certain John Petersen, a wealthy tea planter. The man appears to have been rather an eccentric individual, and in order to prove to the world his belief in concrete as a building material, set about the construction of this great tower. The building took many years to complete, but is entirely of concrete, and by the time the final layers had been placed had reached an altitude of more than three hundred feet. It is about forty years since the tower was erected, and its present condition is certainly a justification of the faith of the builder. As has been indicated, Petersen left instructions that his remains should be placed under the tower, and this was accordingly carried out. Another desire that the chamber at the summit should contain a light was defeated by the firm stand which Trinity House, the lighthouse authority, took on the matter. Such an illumination would have been visible for miles out at sea and would naturally have proved very misleading to sailors.

## Combined Detector and Tuner for Wireless Telegraphy

AT first glance one might be led to believe that the instrument pictured herewith is an ordinary standard double slide tuning coil. However, on closer examination a detector may be plainly seen at *D*. The slider *S* is a common slider similar to that used on any standard tuner. It makes contact by means of a brass ball which rolls on the bared convolutions of the coil. Slider *S* has no ball, but has attached to the lower part a stiff spring *H*, which carries the regulating screw *B*. This screw bears on a lighter spring *C*, to which the detector is attached. The detector is a blunt piece of silicon embedded in a brass cup, and the silicon makes contact with the convolutions of the coil, which are bared along the path of the detector. Thus the bared copper convolutions act as the other element of the detector. By means of the screw *B*, the pressure of the silicon member upon the bared wire convolutions may be varied at will. Direct tuning is accomplished simply by sliding the detector *D* back and forth until the point is found that gives the loudest message.

Of course the detector uses no batteries of any kind, as the rectified current of the incoming waves is sufficient, as in the common thermo-electric detectors, to operate the telephone receivers.

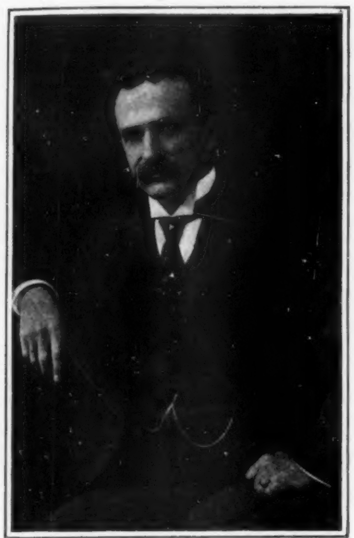
**Blasting With Compressed Air.**—In modern mining the operators are ready and willing to avail themselves of any new methods or devices which will cheapen and increase the production, and a method recently adopted in some coal mines dislodges the mass of coal by the direct application, behind the mass, of a charge of compressed air. The method appears to be effective, and seems to have no elements of danger either to the mine or the miners.

# The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

## Principal Examiner Wm. A. Cowles

THERE must be some compensating element in life that will enable a man, almost a constant sufferer, to maintain the cheerful demeanor and to be the happy exponent of good fellowship



Principal Examiner W. A. Cowles.

of the best kind, such as we find manifested in Principal Examiner William A. Cowles of the United States Patent Office.

A native of Montgomery, Ala., after completing his studies in civil engineering at the Sheffield Scientific School of Yale College, and a short tour of service with the City Surveyor of New Haven, he was appointed topographer on one of the parties of the United States Geographical Survey west of the 100th meridian, serving under Lieut. George M. Wheeler, Corps of Engineering, U. S. A., and was engaged for a number of years in said service. Near the close of the season of 1877, while assisting in building a topographical monument on a peak of the Sierra Nevadas in California, at the headwaters of the Carson River, Mr. Cowles detached a small piece of stone, which unexpectedly and without warning caused the fall of an avalanche of rock, which crashed down the side of the peak, carrying Mr. Cowles with it. That he escaped with his life was a miracle. As it was, he suffered compound comminuted fracture of both legs below the knee, with surgical aid no nearer than Genoa, Nev., nearly 60 miles. Thence he was carried over rough trails and mountain roads, and his legs could not be set until more than three days after the accident. After much surgical experience, until he was finally able to leave a Chicago hospital after many months of treatment, he was obliged to learn to walk anew, and it was several years before he was able to abandon his crutches for the cane which is his constant companion.

After a short service in the Land Office at Washington, he was appointed to the examining corps of the Patent Office, and serving through the grades, was appointed Principal Examiner in June 1905. He has always served in important divisions, and prior to his appointment as Principal Examiner was assistant to the late George Seeley, to serve under whom might be likened to a liberal education in the craft. His classes in the office have included hydraulics, electricity, and the class of masonry, etc., now in his charge. His class at present includes concrete construction, of much importance and marked by much activity at this time, and cutlery, in which safety razors constitute a prominent part.

Mr. Cowles's conduct of his class is not only evidenced directly by the nature of the actions issuing from his division, but by his assistants, who are so sought after as to cause him much inconvenience. An attorney who had been instrumental in securing the resignation of a number of his assistants for the purpose of accepting places outside of the office, once told Mr. Cowles his loss of men was his own fault, since his training and example rendered his assistants desirable men for important outside positions.

## The Need of a New Assignees' Index in the Patent Office

THE statutes relating to assignments of patents provide that an assignment, grant or conveyance shall be void against any subsequent purchaser or mortgagee for a valuable consideration, without notice, unless it is recorded in the Patent Office within three months from the date thereof.

Under the present practice of the Patent Office, all transfers and assignments of the patent property of the country are indexed in the digest of assignments only under the name of the inventor of the invention, application or patent specifically set forth in each instrument.

Prior to 1870 the Patent Office indexed instruments as in indexes relating to realty, that is to say, from party to party. However, as many intermediate links in the chains of titles were not recorded, it was found that after the failure to record any particular instrument, all trace of subsequent transfers would be lost in making searches. To avoid this difficulty, Congress in 1870 made a special appropriation for the purpose of indexing all prior recorded deeds under the name of the inventor, and since that date all assignments recorded have been indexed under the name of the inventor. Therefore, in making title searches of patents, it is necessary to know the name of the inventor of the application or invention or patent involved, and the searches are made by examining the indexes throughout the entire series containing the name of the inventor of the particular application or patent which is being considered.

Frequently attorneys and the general public desire to ascertain what patents are owned by an individual, firm or corporation, and there is no way in which to determine such fact, except to search each of the volumes wherein are recorded assignments, and in which volumes the assignments are indexed from assignor to assignee. As during the period covering the life of a patent, to wit, seventeen years, there are between nine hundred and one thousand volumes, it is very difficult to make a reliable search and report as to the patents owned by any particular person, firm or corporation. As a matter of fact, the term of seventeen years does not cover the possibilities of the case, since an assignment may be recorded many years before the patent issues.

In view of the foregoing, the desirability of a consolidated assignees' index is apparent for the convenience of those searching title for patent property when the name of the assignee only is known or when it is desired to know the patent holdings of any particular person, firm or corporation.

Of course, the record of assignments in the Patent Office is open, but the search required to ascertain the facts above suggested are so extensive and require so much time, that they are rarely undertaken.

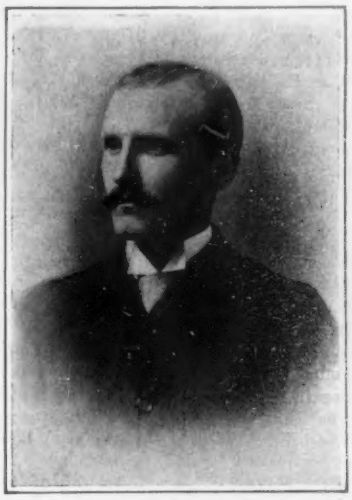
An index of assignees would not only be useful directly in ascertaining the property holdings of any particular person, firm or corporation, but it would also be useful to attorneys as well as to the office in checking up results of an examination based on the index under the inventor's name, and in case of injury or destruction of one of these indexes, the other would be useful in tracing patent titles, as will be apparent to those familiar with this class of searches.

In addition to the value of the index of the character described to the general public, it would be useful to the Bureau of Corporations in any effort instituted by that bureau to ascertain the property holdings of a patent character of any given corporation.

The cost of establishing and maintaining an assignee's index would not be very great in proportion to the value of the index to the public generally.

## J. H. Colwell

AS we survey the remarkable development of science and industry at the present day, we hardly know which calls for our greater admiration, the wonderful perfection of the well-established arts, or the rapid development of the new. The latter perhaps more immediately strikes our attention, and attracts our interest. The opening up of a new field of invention necessarily brings with it a number of secondary consequences, among others the necessity for providing the necessary facilities for coping with the patent situation. The new art of aviation has been assigned to the division of the Patent Office presided over by Mr. J. H. Colwell. This division handles also marine propulsion. Formerly the



J. H. Colwell.

two subjects were dealt with quite separately, but when airships employing propellers, especially those of the "heavier than air" type, came into vogue, it was found that the class of aeronautics included practically no art as related to propellers, and much of such art was necessarily embraced in ship propulsion. Then the close analogy between ships for navigating one fluid, the air, and ships for navigating another fluid, water, became apparent, the relation between ships for propulsion through the air and submarine boats being very close, because they both are immersed in the medium they navigate. The class having been assigned to Examiner Colwell, continued to grow with the very rapid increase of interest in the art, and one of the largest interferences in the history of the Patent Office was declared by Examiner Colwell shortly after he assumed charge of the class.

Mr. Colwell was born in Pennsylvania, and entered the United States Naval Academy in 1877, and after graduating in 1881, studied law and became an assistant examiner in the Patent Office, and was promoted in 1907 to the office of Principal Examiner. His classes in the Patent Office have included electrical signaling and telephony, and many other sub-classes, and his service in the Patent Office has been continuous since his appointment in 1889, except for a period during the Spanish war, when he resigned to accept a commission in the navy, serving on the U. S. S. "Terror" off the coast of Cuba and Porto Rico. It will be remembered that Assistant Commissioner Billings also resigned his position in the Patent Office to accept a commission in the navy during the Spanish war, both Messrs. Billings and Colwell re-entering the Patent Office at the conclusion of the war.

Waterproofing aeroplane wings with a spray of rubber solution applied by means of an air brush.

## Making Aeroplane Wings Impervious

IN order to make the wings of aeroplanes moisture proof and practically impervious to air, so that they will combine great supporting power with light weight, the fabric is impregnated with

rubber. A new way of accomplishing this in a quick and easy manner has been put into practice in France, where aeroplane manufacture has become a recognized industry. After the thin, light fabric has been stitched together and stretched on a frame, a solution of rubber contained in a portable tank is sprayed on the cloth by means of compressed air, as shown in the accompanying photograph, taken in the Deperdussin factory in Paris. The compressed air is supplied by the electrically driven air compressor and tanks on the bogey, and passes through a long rubber tube to the solution tank and thence to the sprayer held in the hand of the operator. A second tube conveys the solution from the container to the nozzle, whence it is drawn and atomized by the current of compressed air passing across the nozzle. It is the same principle as that of the air brush which artists use. Railroad freight cars are now also painted in this same way with the most surprising rapidity.

## Notes for Inventors

**Some Interesting New Inventions.**—Among the interesting patents recently granted, is the patent 990,869, to residents of Antwerp, Belgium, for an electric switch operating device; 990,879, to an assignor of the Cooper Hewitt Electric Company for a tilting lamp, including a negative electrode of conducting liquid, wherein the device is started into operation by the rupture of a stream or layer of conducting liquid; 990,893, for a pilot-cell for electric storage batteries; 990,897, for a flying machine having a metallic gas container of generally rectangular form with its front end forming a lifting plane in connection with helicopters and operating means; 990,958, 990,966, 990,976, 990,985 and 991,038, for various inventions assigned to Westinghouse Electric and Manufacturing Company; 991,012, to Gillette Safety Razor Company, assignor, of an apparatus for hardening and tempering. Patents 991,105 to 991,114, inclusive, have been granted to William A. Turbayne of Lancaster, N. Y., assignor, for electric systems of distribution, except patent 991,113, which is for a charging apparatus. A patent, 991,804, has recently been granted to Schmidt, of Cincinnati, O., for what is termed an Easter rabbit, including a casing which may be shaped as desired and a magazine in the casing from which egg-like objects may be discharged, the invention being embodied in the patent in a rabbit-like figure whose tail may be pressed to eject the egg-like figures from the mouth of the figure. A patent, 991,472, has been issued, for a climbing device having sections to receive the foot of the user and sections to embrace a pole so that user of the device may walk up or down a pole as desired.

**The Water Monkey.**—As summer approaches and the demand for cool drinks increases, it is well to consider some means of securing a palatable cold drink that will not only be free of the objections raised by many to iced drinks, but will also be economical. Those who have been on shipboard in the tropics will recall the water monkey, a porous jar filled with water and hung in a breeze so that evaporation from its surface would cool its contents. Now that electric fans are universally used, it seems someone should invent a convenient, effective holder for a water bottle with wet cloths or some similar absorbent covering for the bottle to place in the range of an electric fan so that the latter would, by evaporating the water from around the bottle or other water holder, cool the water to a pleasant temperature for drinking. This need not in any way detract from the primary purpose of the fan and the cooling device could be made entirely independent of the fan and of the bottle and adapted to receive any desired form of water-holding vessel.

## RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

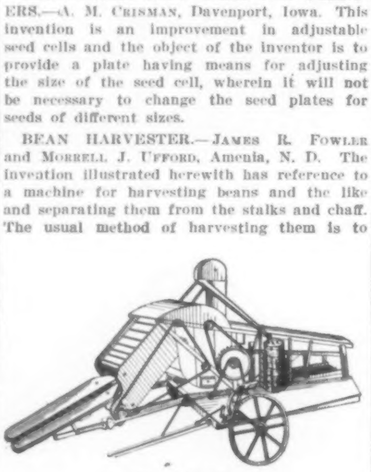
### Electrical Devices.

DEVICE FOR PREVENTING SEASICKNESS AND ALSO APPLICABLE TO LIFTS ON BOARD SHIP.—H. BAUMGARTNER, Bradford, Yorkshire, England. This invention comprises a spring suspension device for the cage whereby the shocks arising from the starting and stopping are effectually cushioned or absorbed; a locking device for maintaining the cage stationary in its support to allow of passengers entering and leaving it conveniently; a pawl and ratchet device for preventing the undesired fall of the cage; and a simple form of electrical and other mechanism for controlling the working of the engine.

### Of Interest to Farmers.

ADJUSTABLE SEED CELL FOR PLANTERS.—A. M. CRISMAN, Davenport, Iowa. This invention is an improvement in adjustable seed cells and the object of the inventor is to provide a plate having means for adjusting the size of the seed cell, wherein it will not be necessary to change the seed plates for seeds of different sizes.

BEAN HARVESTER.—JAMES R. FOWLER and MORRELL J. UFFORD, Amenia, N. D. The invention illustrated herewith has reference to a machine for harvesting beans and the like and separating them from the stalks and chaff. The usual method of harvesting them is to



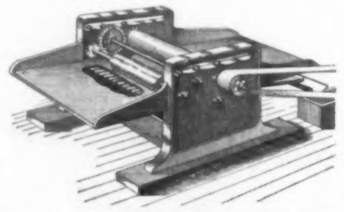
BEAN HARVESTER

pull them by hand and pile them on the ground until ready for threshing. This renders them liable to be spoiled by dampness and by mixing with dirt. The object, therefore, is to provide a device which will automatically pull the vines, thresh the beans from the stalks, separate them from the chaff, and sack the separated beans.

MILKING STOOL.—G. A. MALMGREN, Aitkin, Minn. This stool is adapted to be readily manipulated at the side of the animal to be milked. The aim is to provide a device which will be extremely simple in construction, strong, readily adjustable, and with few corners and crevices to harbor dirt and dust, so that it will be perfectly sanitary.

CONVEYER.—J. OFFERGELT, Honolulu, Hawaii. The invention has for its purpose a conveyer in which the derrick cars are provided with appliances to stably and stationarily hold them during the loading operation, and adapt heavy loads to be carried to the cable without danger of the cars overturning or otherwise deranged or accidentally shifted.

SUGAR CANE CUTTING AND CRUSHING MACHINE.—PABLO A. PICÓN, Merida, Venezuela. The machine shown provides means for severing cane into strips preliminary to introducing the same between crushing rolls; pro-



SUGAR CANE CUTTING AND CRUSHING MACHINE

vides a mechanism with means for separating the strips to deliver the same between the crushing rolls in flat position to present the pith in position to be crushed, the skin or shell being presented edgewise to the rolls to offer the minimum resistance to the crushing strain; and provides means for capturing the juices of the cane as expressed therefrom by the crushing rolls.

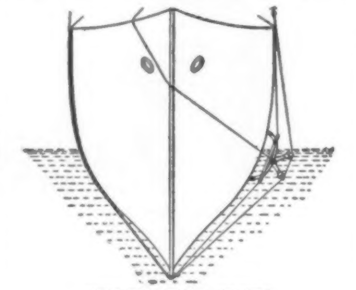
### Of General Interest.

DENTAL INSTRUMENT HOLDING AND STERILIZING BRACKET TABLE.—LENA A. KENT and GUTIE H. TUTTLE, Atlanta, Ga. This invention relates to a combined table and sterilizer, which is adapted to be attached to a dentist's or surgeon's chair or couch, and which is adapted to contain all the instruments and articles necessary for the operator, readily accessible, and in a sterile condition.

METAL BILGE BARREL.—J. H. LAFAVE, Defiance, Ohio. The invention is an improvement in sheet metal barrels, more particularly bilge barrels, and has in view a barrel made up of a number of barrel sections, ordinarily two, which are jointed together on a substantially central transverse seam, with the inner end portion of each section partly extended into and partly extending to the outside of the other section of the seam.

FUMIGATING APPARATUS.—T. H. HOOD, Greenville, Miss. The object here is to provide an apparatus for fumigating books, pamphlets and the like, wherein a large number may be fumigated at one time without injury, and the medicament applied to each and every page, and wherein the act of its application will operate the apparatus to bring each of the books in turn into the best possible position for securing the medicament.

SHIP CLEANING DEVICE.—CHARLES F. HOLLAND, Elko, Nev. This device is for use in cleaning the hulls of ships and other vessels, by a process of scraping; in removing barnacles and other marine growths and the like, and the invention has reference more particu-

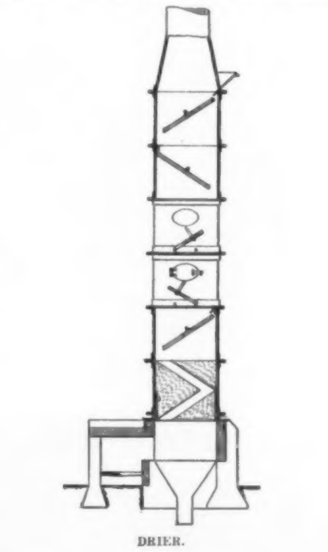


SHIP-CLEANING DEVICE

larly to a device comprising a foldable frame, a scraper carried thereby, and means for moving the frame in juxtaposition with the ship's hull. The device shown in the engraving can be used while the ship is in motion, and its use does not require that the vessel be placed in dry dock or taken out of water.

MEAT COMPRESSOR AND RETAINER.—H. HUTSON and W. S. HUTSON, Pocatello, Idaho. This invention compresses hams and other pieces of meat (generally after the bone has been removed) in an expansible and contractible cylinder, and has in view a device having one or more chains or like members arranged to pass around the cylinder and cross underneath, and a lever to draw the chains tight about the cylinder and compress the meat, and having hooks to engage in the links of the chains.

DRIER.—CLAUDIUS F. MERRITT, Inverness, Fla. The purpose here is to produce a device especially suited and adapted for drying phosphates, graphite, cement, and like materials, by passing the material through a substantially perpendicular tube, provided at intervals



DRIER.

with transverse inclined screens, while subjected to a current of heated air, arising through the tube. The device illustrated herewith may be cheaply constructed with respect to efficiency, easily operated and maintained in condition, with the smallest possible outlay for operation and maintenance.

CHIMNEY TOP.—F. L. J. BOETTCHER, Washington, D. C. In this invention the improvement is in chimney tops having for an object to provide simple means whereby to promote and facilitate the escape of smoke in all kinds of wind and weather, thus initiating and enhancing the natural draft incident to the rise of heated air, also to provide means for preventing the striking back of the smoke down the chimney.

LEVEL.—M. D. JONES, Florala, Ala. In use, the rod is forced into the ground and the support placed upon a stiff-arm with its pivot-projection resting in the depression, the level having been previously fixed in place. The plummet at once brings the level to horizontal position, or, if it has not been properly adjusted upon its frame, any departure from the correct setting may be compensated for by manipulating the screws. When changing the position of the device, the level and its frame can be removed and carried in one hand, the rod withdrawn with the other, and upon fixing the latter in its new location and placing the frame upon it, the level will at once arrange itself horizontally.

### Hardware and Tools.

HANDLE FOR SAFETY RAZORS.—L. SCHWARTZ, New York, N. Y. The object here is to furnish a handle in which a blade can be quickly and effectively clamped. The parts of the handle can be readily taken apart or assembled. The head member which holds the blade is constructed in such a way that it can be removed without removing any other part from the handle.

LEVEL.—GEORGE H. PRIER, New Dorp, S. I., New York, N. Y. The utility of this device will be readily understood on a view of the illustration. The hangers are inserted over a line, such as a mason's line used in laying stone or brick, and the latter adjusted until a

LEVEL

bulb indicates that the proper level has been obtained. If the level is not in true, or it is desired to have the level arranged at a predetermined angle, it can be readily adjusted by adjusting one or both of the hangers by screwing them into or out of the plugs. It is simple in construction, active and positive in use, and inexpensive to manufacture.

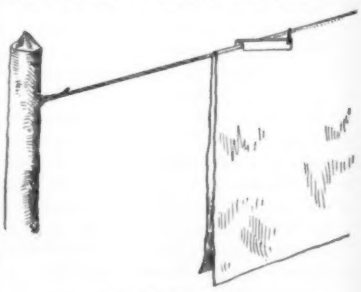
SASH FASTENER.—J. H. BOBBITT, Holstein, Neb. This device removably engages the sash of a window or the like to hold the same in a locked position. Use is made of a rack mounted on a collar in engagement with a spindle, and means engaging the spindle for removably holding the spindle in a locked position to engage the rack with the sash of a window, to hold the same stationary.

HOSE COUPLING.—W. J. ROLLE, Oilfields, Cal. This coupling is of a type adapted to connect together two sections of any hose. An object is to provide a device which will be attachable and detachable in the shortest possible time. A further object is to provide a coupling comprising a pair of interfitting members having an efficient automatic packing disposed therebetween.

ATTACHMENT FOR DOOR CLAMPS.—F. W. LANE, Chico, Cal. This attachment is used in the manufacture of doors, sash, blinds, etc., in clamping the various parts together, as the stiles and rails, and the purpose is to present appreciable friction between one of the jaws of the clamp and the door or similar piece of mill work, so that the stiles and rails will be brought at exactly right-angles to each other when the door is fully pressed together.

### Household Utilities.

CLOTHES CLAMP.—JOHN W. FINCH, Bentonia, Miss., care of J. L. SIBLEY, Bentonia, Miss. The manner of using the clamps is shown herewith. The fabric having been applied to a line, the clamp is then fixed in the



CLOTHES CLAMP

position shown, by which the slot in the plate receives both the fabric and the line. The edges of the plate at the slot engage and twist the line and fabric, thus holding them firmly clamped together, the line being deflected or kinked as shown. To detach the clamp, it is only necessary to knock-up the hook.

### Machines and Mechanical Devices.

TURNSTILE.—H. A. GORDON, East Orange, N. J. The invention provides a construction wherein are employed arms elliptical in shape in cross section; provides automatic means for partially turning the arms employed in the turnstile to economize housing space for the structure; provides a mechanism for rotating the arms of the turnstile to avoid jamming the same; provides releasing means for the stile and a transmission mechanism connecting these means with a visible register adapted to totalize the operations of the releasing device; and provides an auxiliary device operable without affecting the register.

**NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.**

## INQUIRY COLUMN

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry may be repeated.

MUNN & CO., Inc.

**Inquiry No. 9241.**—Wanted, addresses of owners of deposits of molders' sand suitable for heavy castings.

**Inquiry No. 9242.**—Wanted, addresses of makers of bag valves.

**Inquiry No. 9243.**—Wanted, address of maker of Rover's monogram embossers.

**Inquiry No. 9244.**—Wanted, address of manufacturers making rollers, scrapers, and driers suitable for making soap leaves.

**Inquiry No. 9246.**—Wanted, addresses of parties having raw materials or minerals containing potash in any form.

**Inquiry No. 9247.**—Wanted, to buy a Parmelee aerated water.

**Inquiry No. 9254.**—Wanted, the name and address of manufacturers of lead pencils and pen holders, such as are used for printing advertisements on.

**Inquiry No. 9255.**—Wanted, to buy a patent roller, a ball-bearing axle, which could be purchased on a royalty basis; it must be cheap and fully proved.

# Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12461) J. E. P. says: Would you please explain to me why it is that the stars "twinkle"? I have noticed that distant lights of a city are also affected. A. The twinkling of the stars is chiefly an effect produced in our atmosphere upon the waves of light. It is due to currents and strata of air of different densities intermingling and floating past each other, through which the light passes to the eye. It is seen much more in cold than in warm weather, and near the horizon more than overhead. The same effect may be seen by looking out of a window over a hot radiator, or at a candle held on the other side of a hot stove, so that one must look through a body of highly heated air at the candle flame. The flame will be seen to waver and quiver. The various layers of air are at different densities and in motion. Rapid twinkling of the stars is a sign of a change of weather.

(12462) W. F. W. says: I was very much interested in your article entitled "Investigating Peary" in the last number of the SCIENTIFIC AMERICAN, and would like to ask if there is any record of the effect produced on man by the increased attraction of gravitation and the diminution of centrifugal force on nearing the poles. Kindly tell me if the following inference is correct: The earth makes a single revolution on its axis in twenty-four hours. Therefore, a man standing at the equator is being whirled around at the rate of 25,000 miles in twenty-four hours, or more than 1,000 miles an hour, and would inevitably be cast off at a tangent to the radius of the earth, because of the law of centrifugal force, were it not for the attraction of gravitation, which must be sufficient to overcome the centrifugal force. (The effect of gravity must be greater than the centrifugal force, or man would be able to "lift himself by his own bootstraps.") Now, if Peary was at a point, say one mile from the pole, at each revolution of the earth on its axis he would be carried a distance of 3.1416 miles, or at the rate of practically ⅛-mile per hour. Because of his comparatively slow movement, the centrifugal force exerted upon him would be almost immeasurably less than upon the man standing at the equator. Consequently, proportionately less gravitational force is necessary to prevent him from being cast off. Yet, on account of the oblateness of the earth, the attraction of gravitation is greater at the poles. It would seem to me that this attraction of gravitation would be so immense that it would not only prevent all motion, but would also impair both mind and body to such an extent that life would be an utter impossibility. A. The increase in weight at the poles of the earth above the weight at the equator is about nine pounds in a thousand pounds. And in going from latitude 40 deg. to the pole the increase would be about four or five in a thousand, all causes considered. A man weighing 200 pounds in New York would weigh about 201 pounds at the pole. This would not seriously inconvenience him in going there, as anyone can see. Centrifugal force, produced by the rotation of the earth on its axis, causes a diminution in weight of bodies at the equator equal to 1/289 of their weight if the earth were at rest. Thus 289 pounds now could weigh 290 pounds on the equator if the earth should come to rest. This, too, is not an important matter, so far as going to the pole is concerned. The language quoted on the point in our recent article was simply a topic for laughter, even if used by a congressman. Gravity at the equator is 289 times as strong as centrifugal force. These are matters of demonstration to students in mechanics.

(12463) M. D. B. says: 1. Can a dynamo be safely run at the varying speeds such as would be developed by a windmill? A. A dynamo may be run by a windmill, but lamps or motors connected directly to it will not get full voltage and current when the wind is below the force which will keep the dynamo up to its rated speed. Hence the lamps will drop in candle-power and the motors will run slow. A heavy balance wheel will help keep the motion steady in a varying wind, but nothing can avail when the wind dies out. 2. Could a storage battery be charged with the current developed by a dynamo with power furnished by a windmill, varying as it would in speed? A. If a storage battery is connected to a wind-propelled dynamo, the battery will discharge through the dynamo and tend to run it as a motor when the voltage of the dynamo drops below that of the battery. An automatic cut-out is employed to disconnect the battery when this occurs, and to switch it in again when the wind rises again.

## The Heavens in June

(*Continued from page 548.*)

northernmost stars of Centaurus. Observers south of latitude 28 degrees may at this time see the two bright stars Alpha and Beta Centauri, low in the south. The former, which lies to the eastward, is the nearest known star.

Scorpio is rising in the southeast, and Aquila in the east. Ophiuchus and Serpens fill the southeastern sky. Cygnus is low in the northeast, Lyra above it, and then Hercules and Corona, on a line toward Arcturus. Cassiopeia is low in the north, Cephus above, then Draco and Ursa Minor, while the Great Bear is high in the northwest.

Capella is setting below this, and Castor and Pollux are low down on the left. Leo is due west and higher up. Hydra stretches along the horizon from the west to the south.

The small zodiacal constellation Libra, illustrated in our initial, might be overlooked in such a hasty survey. It can, however, easily be picked out between Virgo and Scorpio. Jupiter, which is now near its western border, quite outshines its brightest stars, but two of them—Alpha and Beta Libræ—are above the third magnitude, and fairly conspicuous. The former is a wide double, which is a very pretty object for a field glass.

THE PLANETS.

Mercury is a morning star in Aries and Taurus, and can be easily seen about the first of the month, when he rises about 3:45 A. M. Toward the end of June he is too nearly behind the Sun to be observable.

Venus is an evening star, setting about 10 P. M. all through the month, and very bright. Telescopically she shows the phase of the Moon just before third quarter, on her way to become a crescent.

Mars is morning star in Pisces, rising about 1 A. M. in the middle of the month.

Jupiter is on the borders of Virgo and Libra, and crosses the meridian at 9:40 on the 1st, and 7:40 on the 30th, so that he is visible till the morning hours.

Saturn is in Aries, and rises about 3 A. M. in the middle of the month. Uranus is in Sagittarius, and is due south about 2 A. M. Neptune is in Gemini, too near the Sun to be observed.

The Moon is in her first quarter at 5 P. M. on the 3rd, full at the same hour on the 11th, in her last quarter at 4 P. M. on the 19th, and new at 8 A. M. on the 26th. She is nearest the Earth on the 25th, and farthest away on the 11th. In her circuit of the sky she passes near Jupiter at about midnight on the 7th, Uranus on the 14th, Mars on the 20th, Saturn on the 23rd, Mercury on the 25th, Neptune on the 27th, and Venus on the 29th. The conjunction with Jupiter is fairly close.

At 8 A. M. on the 22nd the Sun reaches its greatest distance north of the equator, and enters the sign of Cancer; but since, owing to the precession of the equinoxes, this imaginary "sign" has moved into the constellation Gemini, this statement is as purely conventional as the other almanac one that on this date "Summer commences."

Princeton University Observatory.

## The Paris-Madrid Aeroplane Race

(*Continued from page 543.*)

at San Sebastian, and descending in a magnificent glide at 10:59. At Arcachon he left France. When passing out over the Bay of Biscay he encountered the worst air eddies with which he has ever had to deal. Near the Spanish town of Fuenterrabia one of his wings grazed a huge boulder on the mountain side and was slightly damaged, although not sufficiently to stop Vedrines, who reached his destination without a mishap. M. Garros made an early start, leaving Angouleme at 5:13 A. M. He crossed the Bay of Biscay successfully, but was detained for over two hours at Fuenterrabia in order to replenish his fuel. He finally reached San Sebastian at 11:40 A. M., his time for the second stage being 6 hours and 27 minutes. M. Gibert lost his way in the fog, and, after flying above the Bay of Biscay for more than two hours, he at length landed at Biarritz to take on fuel. He left there finally, after further delay to fix a defective magneto, and arrived at San Sebastian at 6:53 P. M., having been 13½ hours on the way.

The third stage of the race, a distance of 267 miles from San Sebastian to Madrid, was raced over on Thursday, May 25th, by Garros, Gibert, and Vedrines. The first-mentioned of these aviators, who was racing with an American monoplane built by Alfred J. Moisant, was obliged to descend six miles from San Sebastian owing to a breakdown of his Gnome motor. As he landed on the side of a mountain from which it was impossible to re-start, he was out of the race under the rules. Gibert was the first to start, leaving San Sebastian at 6:28 A. M. He was followed by Garros at 7:12 A. M., and by Vedrines at 7:17 A. M. Gibert and Vedrines passed over Tolosa, about 15 miles from the start, in safety. This place is in the heart of the mountains and at an elevation of about 4,000 feet. It was considered the most difficult part of the journey. Gibert descended at Olazagutia, 40 miles from San Sebastian, to take on fuel and supplies. In attempting to re-start, his machine upset and was damaged. He was obliged to return to San Sebastian and to get help in making repairs. Vedrines flew 125 miles, passing over the city of Burgos at a height of 6,000 feet shortly before being forced to descend on account of a breakdown of his Gnome motor. He managed to repair the motor, but did not finish the flight till the next day. On Friday he re-ascended at 5:20 A. M., and flew without a stop the balance of the distance to Madrid, reaching there finally at 8:09 A. M. His time was therefore 2¾ hours for the 150 miles of the course remaining. He rose to 6,000 feet in crossing the Sierra de la Guadararama Mountains, which are 4,750 feet high. He was greatly fatigued and most perished with the cold. Gibert also finished shortly after Vedrines.

Vedrines, therefore, won the race in about 12¼ hours' time, his average speed the entire distance being about 60 miles an hour. This is 20 miles an hour faster than LeBlanc averaged in the "Circuit de l'Est" last year with his Blériot. When the difficulties of the course are taken into consideration, one can see that the average speed in cross-country work has risen 30 miles an hour in less than a year, as was demonstrated by Vedrines in the first stage of the race. His wonderful flight from Paris to Angouleme in 3 hours and 43 minutes, with a single stop of about a quarter of an hour, has again brought out the capabilities of the modern aeroplane for high speed passenger transport across country. That this machine has shown itself capable of flying at the rate of 75 miles an hour with but a 50 horse-power Gnome motor, when the Blériot monoplane can cover only 55 to 60 miles in the same time, speaks well for the achievement of Blériot's former chief pilot, Leon Morane. His monoplane for high speed passenger transportation differs but slightly in general appearance from that of M. Blériot, but the body has those tapering lines at the front and at the rear which are used by Nieuport on his monoplane—a machine that proved itself some time ago to be the fastest for a given horsepower. When the fact is taken into consideration that the 50 horse-power Gnome motor develops actually about 38 horse-power only, the speed of Verdines in his record-breaking flight is all the more remarkable. Nevertheless, as a performance of speed pure and simple, the record of M. Nieuport made on May 10th, above an aerodrome of 100 kilometers (62.1 miles) in 50 minutes and 36 seconds (74.32 miles an hour) is even more remarkable, since this record was made over a 3.1-mile circular course, and consequently wind could not have affected it. The motor used was a double-opposed-cylinder Nieuport engine rated at 28 horse-power, but developing in reality about 40, or, in other words, about the same as the 50 horse-power Gnome. Everything about the machine was constructed by Nieuport with the exception of the propeller which was made by Regy Frères. Nieuport's previous best performance was made carrying a passenger when he covered

100 kilometers in 59:08, whereas carrying two passengers he required only 8 seconds more. Both these former records were made with a 50 horse-power Gnome motor.

The Paris-Madrid race was organized by the *Petit Parisien* of Paris, the prize being $20,000. In addition to this the Spanish Aero Clubs added $10,000, and King Alphonso offered a special prize for the machine which makes the fastest time over Spanish territory. Competitors in the race were also eligible for the Quentin-Bauchart prize of $10,000, which is open for competition from the first of May until the first of October. Blériot protested against Vedrines' being allowed to start with a second machine after the one with which he originally tried to start was smashed, but in view of his excellent performance with this second machine it is not probable that this protest will be pressed.

### The Current Supplement

THE Heilmann suspension for automobiles is the subject of the opening article of the current SUPPLEMENT, No. 1848.—It is generally recognized that improvements in aerial navigation will be greatly facilitated by a decrease in the weight of the machinery. With this end in view, metals or alloys of low specific gravity have been sought. The alloys so far developed are discussed.—The increasing demand for gold has turned the attention of miners and metallurgists to new fields and new methods. The more notable of these are described by Elmer Ellsworth Carey, under the title, "The Electrolytic System of Amalgamating Gold Ores."—Mr. W. L. R. Emmet contributes a paper on proposed applications of electric ship propulsion.—Mr. Carl Dienstbach writes on the new rigid dirigible of the British Navy.—How a reinforced concrete building was demolished is described and illustrated. —Mr. Willis R. Whitney, director of the Research Laboratory of the General Electric Company, shows what a financial asset research is to a large manufacturing company.—Mr. Saeuberlich concludes his splendid paper on Diesel marine engines.—The lecture recently delivered by Prof. Emil Fischer, of the University of Berlin, on the occasion of the inauguration of the Kaiser Wilhelm Society for the Advancement of Science, was devoted to recent advances and problems in chemistry. The paper is printed in the current SUPPLEMENT.

### Queer Mountain Shadows

THE Peak of Teneriffe projects a huge shadow stretching upward of fifty miles across the deep, and partly eclipsing the adjoining islands. Exaggerated shadows of immense size are commonly seen in many other places. On the Hartz mountains the so-called Spectre of the Brocken throws gigantic shadows of mountain climbers into the sky, repeating every movement made by them. The same occurs on the summit of Pambamarca, in Peru.

On the tops of Alpine peaks, and on the summit of Ben Lomond, in Scotland, mists in one case and rarefied air in the other explain these optical illusions. The same causes produce also colored shadows, varying at each hour of the day, and traceable to the dispersion of the solar rays.

### The Earth's Core

AT a meeting of the Seismological Association at The Hague, Prof. Weichert asserted that his studies of the varying velocity of earthquake tremors, passing through the interior of the globe, lead to the conclusion that the earth consists of a central core of iron or steel, about 5,580 miles in diameter, surrounded with a stony shell 930 miles in thickness. Between the outer solid rind and the inner layer of rock, covering the metallic core, he thinks there is a layer of liquid, or plastic material, lying a little less than 20 miles below the surface of the earth.

**Australian Antarctic Expedition.**—The Australian Association for the Advancement of Science has granted £1,000 toward the proposed Australian Antarctic Expedition, under Dr. Mawson.

## Aeronautics

**The Launching of the British Naval Airship.**—On Monday of last week the huge rigid dirigible which has been built for use as a naval scout was launched from its shed at Barrow-in-Furness, England. This new airship is 510 feet long and 48 feet in diameter and has a lifting capacity of 21 tons. It is equipped with two 8-cylinder motors of 100 and of 200 horse-power, respectively. The vessel was constructed by Vickers, Sons & Maxim, after the general design of a Zeppelin airship. A new metal known as duralium, which is said to be lighter than aluminium and stronger than steel, yet without liability of oxidation, is used largely in the framework. The name of the new airship is the "Mayfly."

**New Aviators at Belmont Park.**—Most of the sheds at Belmont Park are occupied at the present time, the majority of them being filled with new aeroplanes in the course of construction, some of which embody novel ideas. Among the practical machines which have been making daily flights are the Queen monoplanes piloted by Arthur B. Stone, who is a licensed aviator of the Aero Club of France. This machine resembles the Blériot closely, and has shown itself to be a sure and steady flyer. Two biplanes constructed by F. P. Schneider have been flown with success by the builder and his aviator, Joseph Richter. On May 24th the latter made a 12-mile circuit across country with a passenger after he had mounted a new Roberts two-cycle motor upon his machine. Earl L. Ovington has also been making flights with his 70 horse-power Blériot.

**Aviation Meets in America.**—There was a general exodus of aviators from Mineola and Belmont Park last week brought about by important flying engagements in various parts of the country. Capt. T. A. Baldwin packed up his new metal-constructed biplane and sent it to Columbus, Ohio, where a meet is being held this week. Earl Ovington and Tom Sopwith, the winner of the De Forest prize for a flight across the English Channel, are also participating in the Columbus meet. Aviator Arthur B. Stone and Aviator George C. Nealy have taken their Queen and Blériot monoplanes to Newark, N. J., where the first aviation meet in that city is being held at Olympic Park. James V. Martin, the vice-president of the Harvard Aeronautical Society, who has learned to fly in England, is returning with Mrs. Martin, who is an aviatress and who will participate with her husband in an aviation meet at Waltham, Mass., on June 15th. Arrangements are now being completed, and a fund of $100,000 has been raised, for a big aviation meet at Chicago from August 12th to 20th. In addition to these meets, Curtiss and the Wrights are giving exhibitions continuously at various cities throughout the country.

**Recent Aeroplane Accidents.**—Headed by the fatal accident at Issy-les-Molineaux on Sunday, May 21st (as mentioned elsewhere in this issue), there have been a number of more or less serious accidents with aeroplanes during the past couple of weeks. The same day that the French Minister of War was killed an aeroplane fell upon the crowd of spectators at Odessa, Russia, injuring a large number, five of them fatally. Two days later, at Strasburg, Germany, Aviator Laemmlin fell 200 feet and was instantly killed. On May 23rd also, at Bristol, Tenn., Anthony Jannus, the young Washington aviator, deliberately steered his machine sharply to earth to avoid running into a crowd. He was thrown 100 feet or more, but fortunately he was not fatally injured. The same day, during the course of an aviation meet at Augsburg, Germany, Aviator Swandt swooped down on the spectators, killing one and fatally injuring two others. On May 25th, at Hendon, England, a pupil named Benson fell to the ground when making a sharp turn and was killed. Some of these accidents were no doubt caused by failure of the motor, but nevertheless they should be a lesson to aviators not to try tricks like swooping close over the heads of the crowd, which, if anything goes wrong, are sure to result fatally.

## Science

**Sir Ernest Shackleton's Arctic Plans.**—In the columns of the New York *Times*, Sir Ernest Shackleton denies his intention of leading an expedition to Crocker Land. He expresses himself pleased at the idea that the American Museum of Natural History, of New York, will send an expedition to Crocker Land.

**Dr. Samuel H. Scudder.**—Dr. Samuel H. Scudder died on May 17th, at Cambridge, Mass., at the age of 74 years. A graduate of Williams and of Harvard, he was a custodian of the Boston Society of Natural History from 1864 to 1870, assistant librarian at Harvard from 1879 to 1882, paleontologist of the United States Geological Survey from 1886 to 1892. For two years (1883 to 1885) he was the editor of *Science*. He was an authority on Lepidoptera, Rhopalocera, Orthoptera, and fossil insects.

**The Solar Parallax.**—The recent near approach of the small planet Eros to the earth afforded an opportunity, which was embraced by many astronomers, of making a new and accurate determination of the earth's distance from the sun. Arthur Hinks has reduced the observations, and has obtained for the solar parallax the value of 8.806 seconds of arc, which corresponds to a distance of 149,228,000 kilometers, or 92,725,802 miles. This value is probably more accurate than any previously obtained. It is somewhat smaller than the values given in most manuals of astronomy.

**Improving the Sugar Beet.**—The question of improving the sugar beet has come up in France, and many growers were surprised to learn that according to recent figures France occupies only the fifth place as to the amount of sugar produced per acre of beets. It is evident that the quality needs to be improved, as Germany, Belgium, Austria and Holland are in the lead. Besides, the sugar industry finds it difficult to obtain a beet supply, as the growers prefer to sell to alcohol producers, and the sugar manufacturers cannot pay a high price, this being limited by the present low price of sugar.

**Conveying Light by Glass Rods.**—There is a simple and ingenious plan for conveying light to graduated circles at the point where they are to be read with the aid of an attached microscope. It is desirable not to bring the source of light near the circles, on account of the heat, and so the light is sent through a solid glass rod, letting it shine in at one end and emerge at the other. The light cannot escape from the sides of the rod owing to internal reflection, and accordingly it is carried and delivered very much like water in a tube. Even when bent the glass rod does not lose its charge.

**The Origin of Precious Ores.**—Men sometimes dream of enormous wealth stored deep in the earth, below the reach of miners, but experts aver that there is little or no ground to believe that valuable metallic deposits lie very deep in the earth's crust. Such deposits, it is said, are made by underground waters, and owing to the pressure on the rocks at great depths, the waters are confined to a shell near the surface. With few exceptions, ore deposits become too lean to repay working below 3,000 feet. Nine mines in ten, taking the world as a whole, are poorer in the second thousand feet than in the first thousand, and poorer yet in the third thousand than in the second.

**The Antiquity of Man.**—It has been known during a long time that in Western Europe man existed during the glacial epoch. We now know that the great ice age consisted of different glacial times separated by interglacial times. In glacial times the snow line dropped 3,000 or 4,000 feet below its present level in the Alps, whereas in interglacial times it lay about 1,000 feet higher than at present. Thus the temperature seems to have been higher in the interglacial periods than it is now. There is abundant evidence, in the opinion of Penck, that man existed during the beginning of the last glacial epoch. There is some reason for thinking that at least 20,000 years have elapsed since the last glaciation, and that the man whose jawbone was found in 1909 near Heidelberg lived 200,000 years ago.